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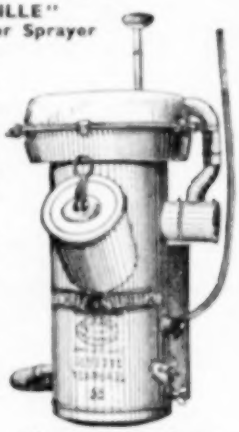

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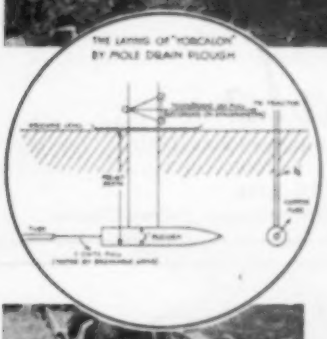

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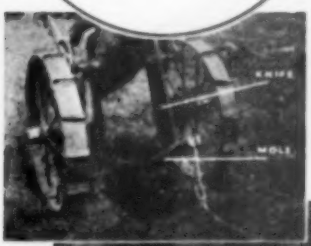

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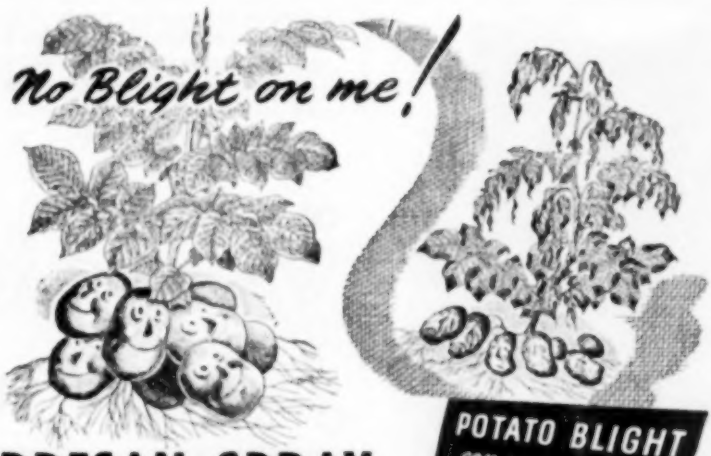

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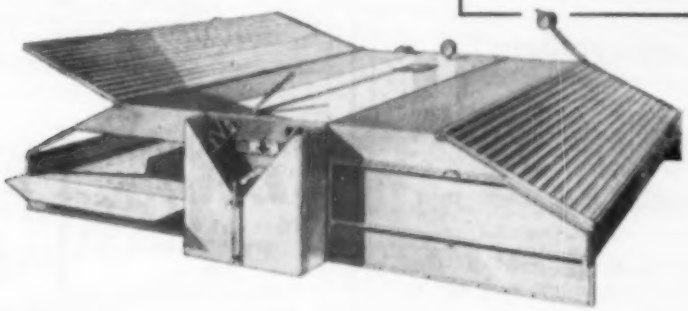

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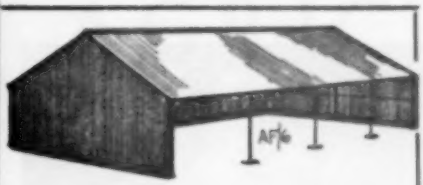

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Editorial Offices: St. Andrew's Place, Regent's Park, N.W.1 (*Phone: WELbeck* 7711)

VOL. LVII No. 2 MAY 1950

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AGRICULTURE

THE JOURNAL OF THE MINISTRY OF AGRICULTURE

VOL. LVII No. 2 MAY 1950

BREAKING OF BAD, OLD GRASS

PROFESSOR SIR JAMES SCOTT WATSON, C.B.E., LL.D.
Director-General National Agricultural Advisory Service

IT is generally agreed that we have still, in this country, some millions of acres of poor old grassland that should, in the national interest, be broken up. Some fields should be reseeded to grass as soon as the land can be brought into fit condition, while others should preferably be brought under a regular rotation.

Ploughing-up grants came to an end with 1949, but a considerable measure of financial help has now been provided in other forms. First, the lime subsidy still stands, whereby both the delivered cost of the material and the cost of distribution are shared equally between the farmer and the Ministry of Agriculture. Secondly, the State is prepared, in the case of grass that is seven or more years old, to meet the greater part of the cost of fertilizers, which must often be applied in substantial quantities if the land is to be quickly brought into full production ; the maximum grant is £3 per acre, being two-thirds of a total expenditure of £4 10s. per acre. Finally, under the extended Marginal Production Scheme, money will shortly be available, on a pound-for-pound basis, for the reclamation of semi-derelict land—for example, where light scrub has to be cleared or where awkward high-backed ridges have to be levelled. These provisions, with the prospective prices for sheep, cattle and corn, should enable the operation to be carried out, on a considerable area, with a long-term profit to the farmer.

It cannot be denied that many past attempts to deal drastically with derelict grassland have met with partial failure, or, where they have succeeded in the end, have resulted in financial loss. Some of the swards that have been made by direct reseeding have, after making a promising start, rapidly deteriorated, bent grass, rushes and other rubbish coming back and ousting the sown grasses and clovers. Again, where tillage crops have been grown, the first, and even the second, has sometimes failed from a variety of causes—wireworm or leatherjacket attack ; failure to achieve the solid tilth so essential for winter corn ; unsuitable or insufficient manuring ; too little or too much lime.

In the first ploughing-up campaign, in 1917-18, total failures were common, partly because farmers had to make shift with poor tools, partly because the work had to be rushed, but largely also because neither farmers nor advisers had sufficient experience to guide them. In the last war these difficulties were again encountered but in less degree, and the proportion of successes was much higher. Today our resources are much more adequate. We have heavy tractors with a wide choice of tools ; abundant supplies of lime and of all types of fertilizers ; and, above all, new knowledge that can ensure against many old risks. We have not, indeed, over-much time, but at least we can take time enough to make good work.

With two particular kinds of old grass, which together make up a big

proportion of the total, there are the strongest arguments for making a start about midsummer—June or early July. The one is heavy land at a low or moderate elevation in districts of moderate rainfall. The largest blocks are in the Midlands, but other considerable areas occur elsewhere, as far south as the Wiltshire Vale and the Weald, as far north as Northumberland, and as far west as the Gloucester Vale. Up till 1939 there was much similar "problem" land in the east—in Essex, Huntingdonshire, Lincolnshire and elsewhere, and something still remains to be done. But large areas have been tackled with most satisfactory results.

Much of this " three-" and " four-horse " land was under cultivation up till the 'seventies or 'eighties of last century, and then produced good crops, especially of wheat. Most of it was either sown down to grass, or more often was allowed to fall down, in the 'eighties and 'nineties, when wheat farming brought so many men to bankruptcy. Some farmers, with the help of slag and by careful stocking, turned their old wheat fields into useful or even first-class pastures. But there was also a lot of " dog-and-stick " farming which led to slow deterioration and which, by 1939, had reduced the land to a semi-wilderness of briars, brambles, thorn, ant-hills and tussocks. During the war a good deal of this type of land was classified by District Committee members as " unploughable "—not because the job of breaking up was physically impossible but because it seemed that the limited resources available could be more usefully employed, with better hope of returns, elsewhere.

The second type for consideration at this season is " marginal " land in the wetter climates of the western and northern uplands. Much of this was first enclosed, cleared and cropped in the good times of last century, and later, during the long depression, gradually slipped back from arable to pasture and from pasture to rough grazing. Deterioration continued as the land became more sour and more phosphate-starved, and the sown grasses have long since yielded place to poor " natural " herbage, including grasses like bents, fescues and Molinia, and very often to bracken.

The objectives will generally be different in these two sets of conditions, and the treatments will differ also. But the first step in both cases should be to find out how the soil stands in respect of lime, phosphate and potash. Guesswork may result in a great waste of money.

Soil Testing It is not difficult to tell, by eye, whether land is sour. But in cases where it is obvious that some lime is needed, it is impossible to say, without soil analysis, whether the dressing should be a ton an acre or twice or three times as much. It is important to avoid excess, not only because the initial investment should be kept as low as possible but also because the excess is subject to rapid wastage. Moreover, excessive dressings of lime may do positive harm—for instance, by locking up the soil manganese and so causing crop failures. Similarly, with phosphate, it takes a chemist to measure the extent of the shortage, and it is expensive to err on the safe side ; moreover, some kinds of land respond well to ground mineral phosphate, which is cheap, whereas in other cases superphosphate or high soluble slag must be used for reasonably quick results. Again, as regards potash it is too commonly supposed that heavy land is mostly well stocked, but potash-deficient clays are by no means unknown ; moreover, almost any land that has been often mown and rarely mucked is likely to need potash in greater or less amount. District Officers can arrange for soil samples to be taken for analysis and, except during the rush periods of autumn and early spring, results and recommendations can be expected in a matter of two or three weeks.

Wheat and Wireworm on Heavy Land On strong land, in reasonably dry areas, wheat has many advantages as the first crop after ploughing out. Its chief drawback, in the past, has been its susceptibility to wireworm damage, which has often caused great loss of plant. During the last war, Advisory Entomologists were able, by washing out samples of soil and making counts, to provide reasonably accurate estimates of wireworm population. Numbers in old grass vary (for reasons that are not yet understood) from a few thousands to a million or even two million per acre. Knowing the numbers present, it was possible to work out a cropping plan and a cultivation programme that would be likely to avoid serious loss. In extreme cases the only sound advice that could be offered was that the land should remain in grass, and a fair number of fields that might otherwise have been broken up were in fact left alone.

A wireworm count may still be very useful as a guide to the sequence of crops ; but individual corn crops can now be protected by the use of a "dual-purpose" seed dressing. This consists of the usual mercury dust (for the prevention of Smut and certain seedling diseases) together with a purified form of gamma-benzine-hexachloride as a protection against the wireworm. Most seedsmen are able to supply ready-dressed seed at an added cost (for the combined dressing) of about 12s. 6d. per acre. Control is not absolute, but the many experiments that have been done show that wireworm damage to the treated crop is reduced to 10 per cent or less of that suffered by untreated seed.

Tillage Wheat cannot be expected to grow well if the surface mould is separated from the subsoil by a spongy mat of turf ; hence, in most cases, it is a mistake to plough deep the first time, for in that case the turf can neither be broken up nor sufficiently consolidated. The best start is a shallow ploughing—about 4 inches—in June or early July, the plough being so set as to cut almost (but not quite) the full width of the furrow. Skims should be fitted to ensure a complete cover, and the furrow slice should be laid as nearly flat as possible.

Two or three weeks later the furrow should be cut up with heavy discs travelling the first time along the line of the ploughing and afterwards diagonally. In some cases two turns of the discs will suffice, while in others a third may be needed. After another short interval the cut-up turf should be pulled to the surface with a cultivator, and the land should afterwards by moved once or twice to ensure a complete kill. Finally, and preferably by about the end of August, the land should be deep-ploughed—10 inches if possible—so that the turf need not be disturbed for two years. Under many circumstances a two-furrow will do better work than a three-furrow plough. By October the soil should be weathered sufficiently to enable a good wheat seedbed to be produced by discing.

All this is fairly straightforward if the surface is reasonably even and if there is no drainage problem. If the original surface is rough—e.g., with ant-hills or tussocks—the only modification needed is two or three turns of a heavy disc before the first ploughing. A more difficult problem is presented by land that lies in high and perhaps crooked ridges.

Ridge-and-Furrow There are obvious advantages in laying the land flat, or at least in reducing the height of the ridges. Hesitation about doing so arises from two fears. The lesser of these is that if the top soil is removed from the crown of the ridge, the bare subsoil will produce little or nothing in the way of a crop. This can be largely overcome

by applying extra fertilizer. The other is that the filling up of the furrows will destroy the only existing means of drainage.

A satisfactory and cheap method of draining is to run a mole along the bottom of each of the old furrows, or, if necessary, three parallel moles, one in the furrow and one on either slope. A tiled main is generally essential. But this can be well done only early in the season, whilst the subsoil is moist. It is, however, a fact that newly broken grassland, if it has been deeply worked, drains much more easily, other things being equal, than old arable. This is because the soil, being full of root fibres, maintains a good crumb structure and does not readily puddle. Unless, therefore, the land lies very wet, mole ploughing may be deferred until the second winter after breaking up. If there is a choice of fields a start should be made on the driest, and the others mole-drained next winter in preparation for later breaking. If the final surface is still moderately ridged, water furrows may be drawn along the line of the old furrows. Hence, in most cases, both the first and second ploughing should be done by setting ridges in the old furrows, and having the open furrows along the crests of the old ridges.

Lime and Fertilizers If a heavy dressing of lime is indicated by the soil analysis, there is much to be said for applying about half before the final ploughing and the remainder afterwards. It is true that lime gradually "sinks" in the soil, but on the other hand the earlier crops may fail by reason of an acid subsoil, even if the top few inches have been well sweetened.

Where the soil has been in ridge-and-furrow and the ridges have been split as suggested, a uniform application of fertilizer will be likely to cause lodging along the line of the old furrows, where the soil has been deepened, or else a poor crop along the line of the old crowns. A suitable plan is to apply a good dressing of balanced compound along the crowns only, and to sow with the seed, and preferably with a combine drill, an additional overall dressing containing a high proportion of phosphate.

Long-term Plan A good deal of land was ploughed out during the war, either with the intention of returning it to grass as soon as the emergency was over or without any definite ideas about its future. Today, when we can look forward to a continuing need for intensified farming, it is well that we should think in terms of rotational cropping for a high proportion of our ploughable land. The choice of a rotation will, of course, depend on the circumstances of the individual farm. But in many cases the aim will be to maintain or increase the head of stock, to provide more in the way of home-grown winter feed, to add a cash crop (wheat) to the farm enterprises, and to get along with a minimum of extra labour. Under these conditions there is much to be said for a simple six-course made up of two successive corn crops and a four-year ley. On land such as is here in question there is much to be said for sowing the grass seeds without a nurse ; and also for breaking the ley, in the summer of its fourth year, in preparation for wheat. If a good level of fertility is maintained there should be no need for the expensive bare fallow.

Reseeding Marginal Land On naturally poor land that is also exhausted of lime and plant food, attempts to complete the whole operation of reseeding, within a single season, have frequently failed. For one thing, it is often impossible to build up, by lime and fertilizers alone, the level of fertility that is required by the better grasses and clovers. For another, it is difficult, especially in a rather wet climate, to

get a rapid and complete kill of the old herbage ; moreover, one must bear in mind that the surface soil will generally contain great quantities of the seeds of native plants. The combination of these conditions is very apt to result in a rapid spread of the old worthless plants in competition with the feeble and ill-nourished seedlings that are expected to make the new sward. The best answer to the problem, so far, is pioneer cropping.

Cultivation and Manuring The time to start is late May or June—May or early June if the land is bracken-infested, and perhaps mid-June in other cases. If the soil is reasonably clear of obstacles, a two- or three-furrow semi-digger type of plough will do a satisfactory job. It should be set to turn a furrow of 11-12 inches wide and 6-7 inches deep. Where this type would fail to do good work, a single-furrow plough set to cut a very wide and fairly deep furrow should be used. If a "prairie-buster" and a tracklayer are available, it may be possible to cut a furrow 12-14 in. deep and 24-26 in. wide. Some other heavy single-furrow ploughs can do good deep work at lesser widths, while recent experience has shown that satisfactory work can often be done even by light-wheeled tractors using a direct-coupled, 16-inch single-furrow plough. On many fields good work requires one-way ploughing. Subsequent cultivation—discing, harrowing, and heavy rolling—are designed to get a well-consolidated and fine seedbed.

In the course of these cultivations the necessary lime should be applied—preferably in the form of ground limestone. Soil analysis will generally have shown an extreme deficiency of phosphate and a dressing of the order of 7-10 cwt. of basic slag, or its equivalent as ground mineral phosphate, will often be needed. Potash may or may not be required, but a moderate dressing of nitrogen—perhaps 1½-2 cwt. per acre—is essential to the growth of the pioneer crop, upon which the build-up of fertility depends.

Pioneer Crops A useful seeding under many conditions is 4-5 lb. of rape with a pound or so of common turnip. On the deeper and better type of land it has been found useful to add 2-3 lb. of marrowstem kale, and on the poorest, about a stone of Italian ryegrass. The seed should be in the ground, and in a well-consolidated bed, by mid-July at latest. The crop can be folded with fattening lambs or ewe hoggs during the period October to January. When folded with hill lambs, each acre of a good average crop, supplemented by perhaps ½ or ¾ lb. of concentrate per head per day, will provide a week's fattening keep for about 200 head. Thus the crop may be expected to return, within a very short time, a substantial proportion of the cost of reclamation.

Unless the land was originally very poor, the aim should be to establish a long ley in the following season. A further ploughing is not only unnecessary but inadvisable, the tilth being made by discing and other surface cultivations which should, however, be continued for some time. In the wetter uplands there is no advantage in early spring sowing ; indeed, the best takes are often secured in June. The young seeds should be grazed as soon as there is a bite, June-July reseedings are particularly appropriate when Italian ryegrass has been sown in the preceding pioneer crop. The grazing programme would then be something like this :

1. October to December — Fold off rape and turnips.
2. January to mid-March — Rest and top dress with nitrogen the Italian ryegrass.
3. End March to June — Graze the Italian ryegrass with ewes and lambs.
4. July — Reseed on disced surface.

In dealing with extremely poor land, it may be advisable to take a second pioneer crop and to postpone the laying down for a further year.

On much of this marginal land the only tillage crops wanted may be for sheep keep, yet the aim should be to take the plough round the farm. A suitable seeds mixture, given adequate fertilizers and reasonably good grazing management, may give a pasture that will remain productive for anything between five and ten years ; but the repetition of the process that has been described, at longer or shorter intervals, should be envisaged in planning for the future.

The writer acknowledges the valuable assistance of several colleagues, including especially Mr. C. Culpin and Mr. C. Kinsey.

THE CRITIC ON THE FARM

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WE have heard a great deal about the Agricultural Expansion Programme in recent months. What does it mean? Simply this. In order to save dollars and imports of food into this country we must increase the output from our own soil. How is this to be done? One way is by greater efficiency resulting in higher yields from existing acreages, be it cereals or animal products. "That's all very well," you say, "but as I am already producing as much as possible, it cannot apply to my farm,"—or can it? The answer of course lies in the answer to another question; are you producing to the maximum from your land, or is it possible that somewhere in your system there is room for improvement? Higher production per acre or per head means more money for you as well as more food for the nation, and if this extra sack per acre, or extra few gallons per cow can be obtained at very slight extra cost to you, so much the better.

You are still doubtful whether it means your farm? All right, let us have a walk round together and discuss it thoroughly. We will start with the buildings.

Are you quite satisfied that your methods in the cow-house and dairy are all that they might be? You know, a churn or two of rejected milk means a loss of both prestige and cash to you, in addition to causing some poor townsfolk to go short of milk that day. All this washing and grooming of cows' rear quarters before milking, washing of hands, wearing clean clothing and sterilizing dairy utensils may seem terribly tiresome sometimes, especially when you or your men want to get away early, but it is worth it. Your cowshed is good, easy to keep clean, has plenty of air and light, but wouldn't it be better if you made a doorway in the wall there, so that your men could get straight in from the foodstore instead of having to go round in the open air? The men have to be considered in these matters, and in any case it would cut down the time needed for the job. Just one more point about the homestead, and it is important. All your liquid manure is running to waste down the drain. It has a good deal of valuable plant food in it, so why not put a storage tank down to collect it?

Now we are out in the home pastures, and there is little criticism here. Funny how the best grass on the farm is often the home pasture, is it not? Well, it isn't really, because this is the field where it is handy to turn the cows out at night or to run other stock temporarily, and to where you can easily cart the stackyard cleanings, and shake out your tillage bags. But it makes you think, doesn't it?

Those are rather a mixed lot of cows you have grazing it at the moment. Are you milk recording? No? Well what is your breeding policy? You are grading up with a Friesian bull. Good! What is his pedigree, and how much milk has he got behind him? You don't know, but he was stated to be out of a very good cow when you bought him. But is that enough?

• The hedge round your pastures is spreading a little, don't you think? Yes, you need plenty of shelter I agree, but you could take a couple of feet off that hedge at each side and still have shelter. Multiply two feet by the length of four sides of the fields, and the area soon mounts up—room enough to graze another cow. You see what I mean?

That's a good crop of oats in the twenty acre, and looks like yielding well. What do you say? It rather surprises you because last year the wheat crop was very disappointing. Have you given the field any lime lately? That might be the trouble. If your barley or wheat crops don't come up to expectations, suspect lime is getting short and have the soil tested. Whilst you are about it you might as well get the whole farm analysed, then you are not working in the dark. It's your pocket that's being affected as well as food for the nation. Soil analysis doesn't cost you anything; but liming where not necessary, or, on the other hand, having crop failures through lime shortage or phosphate or potash deficiency, does. I know the oats are good, but they don't mind a bit of lime deficiency, nor do potatoes for that matter; but wheat, barley and roots will soon let you know if lime is deficient.

This field is potatoes this year, I see, and they look good at this side, but what's wrong over there? You bought new seed for this side and got some local-grown for the rest of the field. How many times grown? Supposed to be once, but you couldn't be certain? They cost you less to buy, of course, but are full of virus disease and won't lift half the weight of the rest of the field. Dear at any price, don't you think?

What has happened to the oats over the hedge? You were a bit late sowing them and charlock got the upper hand? A selective weed-killer might have helped both to save your oat crop and avoid a heritage of a further infestation with charlock seed. There is some frit fly damage into the bargain which you are liable to get with late-sown oats. The flies just lie in wait for some farmer who gets behind with his oat sowing.

This grass field we are in now doesn't indicate that you are particularly short of grass. Yes, it does happen in a "droppy" time that grass gets away from your stock, especially on reseeded land, but it's a pity to waste it. Have you ever thought of making it into silage? It is not all that trouble, especially if you make a pit, and it does turn what would otherwise be partially wasted into a protein-rich food for your stock in winter. You see you pay rent for this land and you cannot afford to waste what it yields, so that if you cannot turn it into milk now, ensile it and make it into milk next winter.

Ah! here is some winter food that looks like proving useful. There is plenty of fertility in the land judging by the kale. The mangolds and swedes are good too. A very expensive crop to grow, you say? Yes it is, I agree, but some farmers make it more costly than it need be. I always think, you know, that root crops should be cleaned before sowing rather than afterwards. That may at first sound foolish, but what I mean is this; if you put plenty of work into your root land by ploughing and cross-ploughing several times, not only do you kill several crops of annual weeds, but you get the land into just the right condition for the small root seeds to grow. Kale and swedes like a nice fine tilth for quick germination and rapid growth so that they get away from the "fly" more easily and do not get a check. At the

same time the pre-cultivations are much cheaper than hand cultivations, so that you get two dividends by that little extra work in preparing the seedbed.

I see you have about an acre of land being wasted at the low end of this field. It is wet, is it? Always has been as long as you have known the farm? Have you ever tried to find a drain to see if it is blocked up? It looks to me as though there is a good fall to that dyke over there. Let us have a look at the dyke. Ah! that needs cleaning out for a start. You say it is no good cleaning it out unless your neighbour cleans his too. Well, have you talked to him about it? It would be doing him a good turn as well as yourself if you got out a joint scheme. Have you ever thought how much you are losing each year by having that acre derelict?

This grass field is the farthest land you have is it? Just a rough pasture where you turn out your dry cows. It's rough all right, you wouldn't think the same man farmed it as farmed the home paddock we saw. But why penalize your cows because they are in calf and not bringing anything into the kitty at the moment? I can see it isn't very suitable for the plough, but that is not the only way of improving grass. Take a tip from me and tear it to pieces with some pitch-pole harrows, then give it a good liming. If you follow this with slag after a suitable lapse of time you'll soon find a difference. You will enjoy walking down here of a night instead of feeling depressed each time you see it. Then you will have to improve your arithmetic because you will have to count more cattle when you come.

This is a useful ley we are in now; it does you credit. I'll bet the milk yield jumps when you turn on to this. What was the mixture you used? You just asked your seedsman to send you a mixture which wasn't too expensive? He appears to have served you pretty well, but were you quite wise? Do you leave it to him when you are ordering seed corn or root seed? I'll wager you don't! You say, "I want such and such a variety, it seems to suit my land best." Well, the same applies with grass and clover seed, only more so, because there are different strains of grasses for specific purposes according to your soil, climate and the purpose for which you need the ley.

The next field is a meadow, I see. It has been down longer than the last one, judging by the coarseness of the grass. Don't you think it would be a good thing if it came out and were replaced by sowing down one of your clean arable fields? That would give your arable field a well-earned rest and at the same time give you a field full of humus for further arable cropping.

Well here we are back home amongst the poultry. You've got some passengers here. Just pin-money for the Missus you say. But is that enough? In these days there is money in poultry if you go about the job the right way. Who is in a better position than the general farmer to get the most from poultry? I don't mean a swarm of nondescript fowls always round the back-door, but well-bred birds properly housed in fields where they can be moved on to fresh ground frequently. You have a lot of food on the farm which they would turn into eggs, and on free range they would find a good deal more, keeping healthy at the same time. Have a talk to your wife about it, then, if she agrees, she'll soon be able to buy your shirts and tobacco as well as her pins!

We have had a good walk, and I have enjoyed it. There is nothing like getting out and around your land, especially if you are in a critical mood. Yes, I know I may have exaggerated a little, but I did so because I wanted to make you think, and to shake your conviction that there was no improvement possible on your farm. Perhaps all the points I have raised don't apply to you, but can you honestly say that none of them does?

THE EFFECT OF NITROGEN TOP DRESSINGS ON THE QUALITY OF WINTER WHEAT

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In last month's issue of *Agriculture* Mr. H. W. Gardner dealt with the result of wheat variety trials in Hertfordshire with respect to yield, protein content and recovery of nitrogen in the grain, as affected by a spring dressing of nitrogen fertilizer at the rate of 2 cwt. per acre. Briefly the conditions of the experiments were that in each season plots, sited indiscriminately within the county, were sown with the same ten varieties of winter wheat in single strips. The spring dressing was applied to half of each variety strip by random choice. It was found the dressing had a significantly positive effect on yield of grain (3.6 cwt. per acre) and that the percentage increase was not affected either by the fertility of the plot or the relative yielding power of the wheat variety. It was shown that Bersée and Scandia were superior in yield to all other varieties used in the trial and that the recovery of added nitrogen as grain was of the order of 26 per cent.

Over the years 1945–48 samples from these plots were supplied to the Cereals Research Station for quality tests. The results for the 1945 season have already been published* and the present article deals with milling, baking and analyses for vitamin B_1 in the following three years.

A short description of the nature of the tests used may assist the understanding of the results obtained. As regards milling quality, it may be said that when wheat is crushed to separate the floury endosperm from bran, two distinct types of behaviour may be recognized. The endosperm may break down to particles of regular shape, which will retain their regularity when further subdivided, or it may break down to a fine powder of irregular particles. The former are classified as hard, and the latter as soft. From most points of view the milling of hard wheats is preferred, on the grounds that the regularity of particle shape confers mobility and ease of sifting to flour and milling stocks. A second classification concerns the ease of separation of adherent endosperm from bran. Hard wheat brans are more easily cleaned in this way than soft, possibly because the force required to shear an adherent endosperm particle is greater than that required to detach it from the seed coat. The first classification may be made by granulation analysis of flour from wheats milled by a standard system, the second by a comparison of percentage of grain separated as coarse offal or bran in the milling.

In comparing wheats for bread-making quality, since absolute standards are not available, use may be made of the fact that the most valuable types of commercial wheat (e.g., North American spring wheats) produce typical bread of high volume per standard weight whose crumb is even and finely grained and, though soft, sufficiently strong to remain coherent when cut or spread. The extent to which English wheat flours can approach these standards may be taken as a criterion of their quality. For this purpose a scoring system has been used involving five characters of the loaf, the total score out of a maximum of 50 being taken as an index of baking quality. A standard system of baking has been used throughout, and since in commercial practice improvers are normally used, the test on untreated flour has been replicated with the inclusion of 10 parts per million of potassium bromate.

* Moran, T. and Jones, C. R. *Nature*, 1946, **157**, 643.

As regards analytical data, in addition to nitrogen estimations, vitamin B_1 contents have been determined in a large proportion of cases. The vitamin content of wheat can scarcely be regarded as of consequence to its commercial value, yet bread is among the chief sources of vitamin B_1, and any wheat which by reason of its breeding, or environment of growth, is particularly rich in this nutrient will possess a special interest.

In the three seasons 1946–48, ten varieties were constant in the trial, and comparisons are available for these years at a total of nineteen different centres (6, 6 and 7 respectively).

Milling Quality As regards milling quality a first distinction can easily be made; in all cases Holdfast milled as a hard wheat and the remainder as soft wheats. In sifting analyses of milled flour, as produced on an experimental Bühler mill, that from Holdfast contained 50–55 per cent of particles fine enough to pass a No. 16 silk (aperture 0.08 mm.). The remainder produced 65–70 per cent of such flour. The difference in mobility between these flour types is obvious from inspection. Holdfast is not unique among English wheats in this respect; Yeoman and its hybrids Redman and Warden have the same character.

The soft wheats of the present trial are not distinguishable on the first classification but can be compared for separability of bran. The following example may be quoted. Six wheat samples of each of eight varieties, drawn from three centres and including treated and untreated strips, were milled under comparable conditions. The mean percentages of grain separated as coarse offal or bran were:

Percentage Separated Bran

Variety	Untreated Strips	Treated Strips	Total Range
Juliana	25.6	24.4	24.0 — 26.9
Vilmorin 27	27.9	27.1	26.3 — 28.1
Jubilégem	27.5	28.5	26.0 — 29.4
Little Joss	28.6	28.0	27.5 — 28.9
Bersée	28.7	28.3	27.0 — 29.9
Steadfast	28.6	28.8	27.5 — 29.9
Weibull's Standard ..	29.1	29.5	28.5 — 30.1
Scandia	31.4	31.2	30.4 — 32.0

The effect of nitrogen treatment is negligible, but a varietal effect is evident. Juliana is better than the rest, and Scandia clearly the worst. The difference between these extremes, amounting to some 6 per cent of the grain, is an important consideration, and the objection expressed by flour millers to Scandia wheat, which is of reasonably good bread-making value, arises from this defect in its milling quality. As no method is available for estimating the endosperm content of separated bran, no explanation of the effect can be offered, but it probably represents an increasing order of softness in the grain and corresponding difficulty in the separation of endosperm.

Baking Quality As is well known, the baking quality of wheat varieties is not constant but can be affected by season and location of the growth of the crop. It is worth mentioning that in this trial, which was confined to so small an area, the variations noted were very wide, baking scores as low as 10 and as high as 45 occurring, representing, in the experi-

ence of the authors, almost extreme cases for bad and good bread from English wheat.

The quality of grain can also be affected by its condition of moisture content at and after harvest. It was possible, in the majority of cases quoted, to receive grain samples within 24 hours of harvest and, where necessary, to dry them, at a low temperature, to a safe level. Nevertheless, in the wet weather of both 1946 and 1948, "growing out" occurred in the grain of some varieties to an extent sufficient to make them no longer of use for baking tests. (In flour from germinated wheat there is, during baking, undue hydrolysis of starch to dextrins which render the crumb sticky and destroy its texture.) There was no such occurrence among the red grained varieties, but all three white grained wheats suffered to some extent—Holdfast in 1946 and particularly so in 1948, Juliana and Steadfast in 1946 and slightly in 1948. In all cases the germination had occurred in standing corn and, although the extent of growth was slight, the percentage of grains affected was of the order of 40 per cent. The fact that other varieties remained practically unaffected while receiving the same weathering treatment, points to the risk of damage attaching to these wheats in wet harvest weather.

Apart from samples omitted on the above grounds, all the remainder can be used to investigate the general effect of spring dressing on grain quality and 171 comparisons with and without treatment are available. These are:

Variety	No. of comparisons	Mean Baking Score		Difference
		untreated strips	treated strips	
Bersée	19	25	25	0
Holdfast	9	38	41	+3
Jubilégem ..	19	28	31	+3
Juliana	16	24	25	+1
Little Joss ..	19	19	18	—1
Scandia	19	31	32	+1
Squarehead II ..	19	25	24	—1
Steadfast	16	22	22	0
Vilmorin 27 ..	19	29	28	—1
Weibull's Standard	19	27	25	—2
Mean		26.8	27.1	+0.3

The differences are small and show no general trend; the standard error of the mean difference is 0.27 and the significant difference for means of varieties 1.6 units at the 5 per cent level. (In the case of Holdfast with 9 comparisons the difference is 2.3.)

It would appear, therefore, that no change in quality worth consideration has resulted from the fertilizer treatment and that the increase in yield of grain has not been at the expense of quality.

Apart from the effects of fertilizer treatment, the comparisons provide data for estimating the relative baking values of the different varieties and the changes brought about by season and locality. For this purpose, the mean values of treated and untreated strips have been used, varieties for which samples cannot be included, being omitted. It may be pointed out, however, that in every trial for which comparisons are available, Holdfast gave the best baking result and there is no doubt as to its superiority in this respect.

The remaining seven varieties were tested at nineteen centres, giving, in all, 133 scores. The variation of these scores can be subdivided by the usual methods of analysis of variance into different portions due to locality, variety, season and some interactions of these three factors. By using the appropriate estimate of error, the effect of the three factors can be shown significant. The results tabulated not for locality but averaged for each season are given below:

Variety	Mean Baking Scores for All Localities				
	1946	1947	1948	Mean of 3 seasons	Order
Bersée	17	34	25	25	5
Jubilégem	35	31	25	30	2
Little Joss	13	29	14	19	7
Scandia	29	33	33	32	1
Squarehead II	18	33	25	25	5
Vilmorin 27	23	36	28	29	3
Weibull's Standard ..	31	29	22	27	4
Mean of all varieties	24	32	25	27	

The difference between means which will be significant at the 5 per cent level is:

For variety means over 3 seasons 2.0 units
For variety means over 1 season 3.6 units
For season means 1.3 units

It may be concluded that the order of bread-making quality suggested by the all-season means is valid, but that over the three seasons, the exceptional weather of 1947 was the most potent factor affecting baking quality within the limits of the trial.

An aspect not covered by this analysis concerns the relation of grain protein content to baking quality. In the case of Holdfast, there is evidence to suggest that the two quantities can be correlated without serious intervention of season or locality. If this suggestion is correct, it follows that when nitrogen dressing results in an increase in grain protein, an improvement in quality will follow. Further experiments involving later dressings with nitrogen may throw light on this point.

Vitamin B_1 Content As has already been stated, the vitamin B_1 content of wheat cannot be regarded as a quality factor unless considerable differences occur. No such differences have been found in these trials, but the result may be worth a brief statement. First as to the effects of the spring dressing, 110 comparisons are available for the 1947 and 1948 seasons. Their mean values, expressed in international units per gram of grain, are:

For untreated strips 1.17 I.U. per gram
For treated strips 1.21 I.U. per gram

The difference, though very small, is significant and general among all varieties and can at any rate lead to the conclusion that increase in yield of grain by spring dressing with nitrogen certainly does not impair, and may improve, its nutritive value in this respect. A further analysis is unnecessary here but as a matter of interest the variety means for three seasons may be quoted for grain from untreated strips.

EFFECT OF NITROGEN TOP DRESSINGS ON WINTER WHEAT

Vitamin B_1 content, I.U. per gram: Variety Means for Three Seasons

Variety	1946	1947	1948	All seasons
Bersée	1.20	1.25	1.46	1.30
Holdfast	1.10	0.95	1.09	1.05
Jubilégem	0.97	1.00	1.04	1.00
Juliana	1.05	1.06	1.07	1.06
Little Joss	0.99	1.00	1.09	1.03
Scandia	1.00	1.02	1.04	1.01
Squarehead II	0.97	1.04	1.05	1.02
Steadfast	1.00	1.07	1.09	1.05
Vilmorin 27	1.12	1.10	1.13	1.12
Weibull's Standard ..	1.02	0.92	1.05	1.00

The French wheat Bersée is shown to be the best source of this vitamin.

Conclusions Among the varieties tested, no significant effect on milling and baking quality has resulted from the use of a spring dressing of nitrogen. A slight but positive effect on vitamin B_1 content has been noted.

Within the range of the test, Holdfast has shown superior milling and baking quality to all the other wheats tested. Among the remainder, the season has been shown to be the most important factor affecting baking quality, and wheat variety is more important than locality of growth. Next to Holdfast, Scandia has the best baking quality but the poorest milling quality.

DAIRY FARMING IN NORTH WALES

THE PLASNEWYDD FRIESIAN HERD

E. G. E. Griffith

THIS article gives a brief account of how a high-yielding dairy herd has been built up and how it is managed, and presents a picture of the change-over from stock rearing and grazing to dairying, which has been such a marked feature of modern farming. Plasnewydd has been farmed by successive generations of my family since 1840, but it was not until 1935 that we decided to concentrate on milk production, a purpose for which the land and situation are particularly suited. In that year we took over the old-established Ince Herd of pedigree Friesians and purchased three or four additional heifers, and from these the Plasnewydd herd is descended. We were fortunate to obtain a sound foundation—though indeed anyone could do the same during the period of low prices—and our next problem was to decide exactly what we intended to do. We did not want to keep cows; we wanted the cows to keep us. The first essentials were a definite policy and a definite plan of action.

A Careful Breeding Policy We were convinced—and time has strengthened our conviction—that the only type of herd which could properly be described as "commercial" was a self-contained,

pedigree, milk-recorded herd. In this way alone we could breed and manage the cattle to advantage, and attempt to control disease. Our aim throughout the years has been to breed healthy, long-lived animals of strong constitution, regular breeders, and heavy milkers who will do their job on twice-a-day milking and without coddling. We expect a mature cow to give us at least 1,500 gallons and a calf a year, and in fact a number of them reach the 2,000 gallon mark. We expect, too, that *all* our heifers—not just a proportion of them—will prove themselves good dairy cows. How far these "great expectations" have been realized may be judged by the fact that the official herd average for the last six years has been 1,355 gallons; for last year alone, 1,416 gallons. There is nothing very wonderful in these figures—they could be greatly increased by the adoption of three-times milking, and they could be emulated by anyone who would adopt a sound breeding policy and a careful system of management. One must have good cattle and good management—neither is of any use without the other.

In building and maintaining a herd, everything depends on the selection of the bulls. Proven sires? Yes, of course, if you can find them, and if they suit the lines of blood in your herd. But real proven sires are very hard to find—they always will be—and in practice one generally has to buy an untried bull, relying on a careful study of his pedigree, the production performance of his relatives, and the general high standard of the herd from which he comes. We have had to select our bulls in this way, and, as it happens, each bull we have used has proved a most successful sire. Perhaps we have been very lucky, but we have at least done everything possible to eliminate the element of chance when choosing the bulls. We still have two or three daughters of our first purchase, Thrundle Joy Beatty; one of them has given nearly 60 tons of milk, another over 55 tons. Beatty gave us a start, and our next step was to work out a long-term plan, to choose what appeared to be the best herd in the country for real commercial qualities, and to obtain our bulls from that source, for the successive use of bulls of different blood and from different herds will result in the production of a "collection of cattle" rather than a herd. We decided to go to Terling and Lavenham, and it was indeed a happy choice. Terling Apache R.M. was a truly wonderful sire. Without exception, his daughters were outstanding milkers and had beautiful udders. He sired seventeen R.M. daughters, five 2,000 galloners (two of them twice 2,000 gallons), three R.M.L. daughters so far, and two more near the 50 ton mark and still going strong. One of his daughters, the twice 2,000 gallon cow, Plasnewydd Blissful R.M.L., has calved regularly inside the year, has averaged 1,856 gallons with seven calves, and is rapidly approaching the 60 ton mark by giving 10 gallons a day in her present lactation. The measure of Terling Apache's influence is illustrated by daughter-dam comparisons, which give the daughters an increase of 2,469 lb. in their first, and 3,990 lb. in their second lactations.

Having obtained this superabundance of milk with reasonably good fat, our next task was to find a bull which would further improve the fat without unduly reducing milk, and with this object in view, we bought Steeple Aafrol P.I. R.M., son of a "1936" bull and a cow by a Terling sire, and therefore not too violent an outcross. Aafrol did his duty nobly, his daughters being uniformly good in fat. His thirty R.M. daughters—a very high percentage of all his female progeny— continue to qualify in succeeding lactations. He has been particularly successful when mated with Terling Apache cows. At the same time, we used Whipling Hector—of pure Terling descent, except that his dam was by a "1936" bull. He left only ten daughters in the herd, nine of which were R.M. with their first calves. They have done extremely well in subsequent lactations, being equally good for milk and fat. The

present senior stock bull, Terling Endeavour, was carefully selected to follow Apache and Aafrol, and has already qualified for the Register of Merit, by siring thirteen R.M. daughters—again a very high proportion. His first crop of unselected daughters show an increase in both milk and fat over their dams—no mean performance when the dams' high records are taken into consideration.

Here is a succession of "proven sires" all purchased untried! Just luck?—maybe; but, looking back, what an infinity of time and trouble we took to find them! And, though the bull is half the herd, we have never forgotten that the cows are the other half, and that a herd can be built up only by a continuous process of selection leading to the creation of sound female lines. Without good bulls, mere culling will achieve nothing; given the sires, it will make a herd.

Management based on Recording So much for breeding policy; now for management. A definite system is required and must be adhered to, for it is no use trying to breed good cattle unless one is prepared to manage them with care and method. Fortunately there is no lack of good advice on this subject. There are text-books, writers, and speakers in abundance—I almost said *ad nauseam*—and there is surely no reason in these enlightened days why dairy cattle should still be kept in a way that can bring little profit either to their owners or to the nation.

Starting with the calves, the rule is to keep them in a healthy growing condition throughout their youth. Bull calves, of course, must be done really well, but heifers will be all the better if not overdone with flesh, and for many years we have reared our heifer calves on a maximum of 20-25 gallons of milk. There is not the space here to give a full account of this method of calf rearing: it must suffice to say that the calves thrive just as well as those receiving large quantities of milk. The growing heifers are never allowed to "go back," though they are not overfed or coddled. Calves born after Christmas are not turned out to grass the following summer—they remain in the sheds and yards; their slightly older sisters at grass must be watched carefully to see that they do not suffer from husk, worms, or anything else likely to cause a setback. Subject to that and to the provision of shelter with hay, straw and silage in their second winter, they will look after themselves.

Since we aim at winter milk production, most of the heifers are bulled to calve in the autumn, whilst a certain number are served to calve in July and kept back from the bull after calving so that they become autumn calvers in their second lactations. We prefer heifers to calve at the age of 2 years 3 months to 2 years 6 months, but a well-grown heifer can calve at two years old and be none the worse for it. Heifers which calve when the grass is good do not receive any concentrates before calving; those calving in late autumn and winter receive 6–8lb. a day for a month or so before they are due. After their first lactation they have a two months' dry period—mature cows have six weeks—and during the period all are "steamed up" according to an estimate of what they are expected to give at the peak of their production. On this rest and steaming up the next lactation yield largely depends. We have found no advantage in milking before calving, though we always draw milk from a cow which is obviously uncomfortable.

The feeding and management of the dairy cows is based on daily milk recording. It cannot be emphasized too often that without recording nobody can begin either to breed or to manage a herd, and it is truly astonishing that this elementary fact should not be universally recognized. Weekly

recording is an excellent guide and requires little clerical work; daily recording is better still, since it shows that slight drop in milk which is often the first symptom of "something wrong" and gives the opportunity for immediate investigation and treatment.

For the first few days after calving the cow is fed on a light diet, which is gradually increased both in quantity and protein content till the full ration is reached in a fortnight or three weeks' time. She is then fed according to yield, a little extra being given to lead up to her maximum. First-calf heifers, which have to grow as well as milk, are fed for a gallon over their actual production. These guiding principles may need adjustment for particular animals, since the stockman's art lies in treating his cows as individuals and studying their likes and dislikes. Home-grown beans and oats form the basis of the production ration; these alone may be sufficient for low-yielding cows, while a more complicated ration containing purchased foods in addition is used for the high yielders. Kale is fed in the autumn and early winter and is replaced by silage later on. The maintenance ration consists of hay, very carefully limited as to quantity. Good hay is much too precious to waste, and it is most important to control the bulk fed to high-yielding cows which are receiving a large allowance of concentrates. Good oat straw can be fed to dry cows and low yielders.

In summer the general principles of management are the same, but success largely depends on the ability to make the best possible use of grassland. It must be remembered that grass alone will never be sufficient for more than maintenance and the first three or four gallons, and that cows giving more than this must be fed for the additional gallons; but this fact in no way minimizes the supreme importance of grass. Our object is to ensure a continuous supply of short, fresh grass from early spring to late autumn, and to give the cows frequent changes of pasture and the "fresh bite" they love. To this end, the larger fields have been divided into smaller units, and these are subdivided by means of electric fences, so that the cows are being continually moved on to fresh ground.

Adequate lime and phosphate content, the application of nitrogen fertilizer or a complete fertilizer as and when required, the use of the mowing machine, the choice of seeds mixtures, all play their part. The lush, reseeded pastures are grazed for limited periods during the day; as soon as the cows have filled themselves they are moved to rest and lie down on bare pasture, thus avoiding waste and soiling of the best pasture and saving the cows from indigestion. During the nights they graze on old pasture where they can obtain those deep-rooting plants which may be missing in the new leys. The high yielders get the best grass, low yielders and dry cows come next, and perhaps a bunch of heifers will act as scavengers.

Talking of old pasture brings us to the most important, and often neglected, question of minerals. None of us knows much about minerals and trace elements yet, but it is safe to say that most of the ills that befall stock are probably due to lack of one or more of these substances. From early calfhood, our cattle receive minerals both in the form of licks and mixed in their food. This has always been our practice with dairy cows and housed young stock, and for the last few years we have fed minerals to all young cattle at grass too.

We milk by machine and strip by hand. With most of our cows hand stripping may be unnecessary, and I will not enter into the arguments for and against stripping. It is a question that every farmer must decide for himself; the only important point is that the cow should be milked clean out. Good, quick machine milking is a highly skilled job, not just a matter of putting on the machines and allowing them to tick away till the enraged

cow kicks them off. We use Professor Peterson's hot cloth method for one or two cows, but ordinarily the feeding of each cow as she is milked and the putting on of the machines seems to be an adequate signal for the let-down of milk. It is imperative to have a definite routine, which the cows associate with milking, to induce them to let-down. We milk twice daily—at 6 a.m. and 4 p.m.—the heavy yielders being milked first in the morning and last at night, to equalize the interval as far as possible. Undoubtedly we ought to milk three times daily, and we are hardly fair to our best cows in denying them the opportunity of greater fame; but the third milking is not easy to work into normal farm routine, and, when all is said and done, our object is to produce animals that will give results under normal farm conditions.

Here then is a brief account of a successful commercial enterprise and of the system employed. I have stressed the importance of method, but no system will work unless it is combined with a genuine love of animals. What our fathers called "the stockman's eye" is no less essential today, and quiet and gentle handling of cattle repays an ample dividend. We live in a mechanized age, but cows are not machines, and they will give of their best only if treated with individual care and attention.

THE POSSIBILITY OF ARTIFICIAL PREGNANCY IN CATTLE

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ALL along the line scientific methods are gradually being incorporated into agricultural practice. Before a new scientific discovery can be utilized in practice, however, there is usually a lag of varying time between the discovery and its widespread use. This is because various difficulties in its application to a particular case are encountered and have to be overcome by subsidiary experiments before the discovery will work a hundred per cent and so become a commercial proposition.

The use of fertilizers (synthetic nitrogen, superphosphates, etc.) is now a routine farming practice. Artificial pollination has been used for a long time by experts to produce new varieties of plants, and artificial insemination for animals is now spreading rapidly throughout the world as a cheap and quick means of effecting mass breed improvement. Artificial lactation in cows, by means of the implantation of a synthetic hormone to reproduce the function of the foetus in causing the development of the udder, was discovered during the recent war, but has not yet been widely used because of some defects in the method which have yet to be overcome. Artificial incubation of hens' eggs was used in ancient Egypt and, with scientific improvements, is now widely used in agricultural practice all over the world. The possibility of artificial pregnancy in cattle follows as an extension of this latter practice, for through it attempts are now being made to incubate the eggs of cows of good genetic worth in other, inferior, cows.

The Problem That the fertilized eggs of one animal could be transferred to another animal and develop properly in the host mother up to the time of birth was first discovered by Walter Heape with rabbits in 1890. Until recent times, however, the percentage of successes was so low that there

was little hope of its becoming a commercial proposition. But work done on rabbits during the last few years by Pincus and Chang in the U.S.A. and by Dowling at Cambridge has completely changed the situation and has raised great hopes for its future commercial exploitation in farm animals. By using methods similar to those employed in the storage of semen, Chang has been able to keep the fertilized rabbits' eggs outside the body for four days, put them into the host doe and obtain litters of normal young from them. Dowling[1], by using optimum conditions for transplants, has been able to obtain in a series of rabbits the certainty of result that practical application demands, in that for every 10 fertilized eggs (pure albino) he implanted into host does (black), he obtained 7.8 normal young at birth, and of these 21 were reared into normal healthy adults (Fig. 1). Warwick and Berry in the U.S.A. have successfully transplanted fertilized eggs from one ewe to another (two cases out of nine attempted) and from one goat to another (one case out of twelve attempted), normal young being born and reared.

So far the few experiments which have been done with cattle, largely on unpromising material (slaughterhouse cows), have not resulted in the birth of any living calves, and many problems that have arisen in applying this method of breeding to cattle have yet to be overcome. Considerable progress has, however, been made in many directions during the last few years. At present experiments on different aspects of the problem are in progress under the Agricultural Research Council at Cambridge and at two or three experimental stations in the U.S.A. The purpose of these experiments will first be described, and then an account will be given of the possibilities of its exploitation in the cattle industry of this country. The results given here are taken largely from the experimental work of Dowling [2] and Rowson at Cambridge over the last three years.

The first problem is to be able to increase the number of eggs shed by the cow so that the progeny of cows of good breeding value can be increased in the same way as is done by artificial insemination for the bull. The heifer calf starts life with an average of about 75,000 eggs in the ovaries, but out of all this number even a very good cow will produce at the most not more than about ten calves in her lifetime.

Various methods have been used for increasing the number of eggs shed (Fig. 2) at each heat by the cow, but although twins and triplets can be produced (Hammond, Jr. and Bhattacharya [3]), the excess die off during development, so that litters of calves cannot be produced at present. There is a chemical substance (called P.M.S.) in the blood serum of mares during the 45th to 90th day of pregnancy, which, when injected subcutaneously into cows, will cause a large number of eggs to ripen. This substance is very similar to the natural substance produced by the cow's own pituitary gland (a small gland at the base of the brain) which is the substance in the blood that causes the egg to ripen.

So far, four ways have been found by which the number of eggs shed by the cow can be increased. The first method is to inject 3,000 I.U. (international units) of P.M.S. into the cow some four to ten days after she has been on heat, when she has a large corpus luteum in the ovary, and then four days later squeeze the corpus luteum out. She comes on heat two to four days later and is inseminated. On the average 6.6 and up to 18 eggs are shed as a result, but generally speaking, this method is not satisfactory, for in a number of cases the ovaries are over-stimulated and the passage of the eggs is accelerated down the tubes, so that a large number do not become fertilized, or if fertilized do not develop properly. This may possibly explain many cases of natural sterility that occur in cows.

The second method used was to inject the same amount of P.M.S. some three to five days before the cow is due to come on heat and when she does come on to inseminate her. This is a better method than the last, as on the average 15 and up to 51 eggs were shed, but there were still some cases of over-stimulation of the ovaries in which the eggs did not get fertilized.

The third method is to inject 100 mg. of an extract of horse anterior pituitary gland (which is rich in the stimulating substance) daily for three consecutive days beginning some two to six days before the cow is due to come on heat, and when she comes on, to inseminate her. This was the best method tried, for, though the number of eggs shed was not so large (average 6.5 and up to 25), the ovary was not over-stimulated and practically all the eggs shed were fertilized. Even in the cow which shed 25 eggs (Fig. 3) all the eggs were recovered from the tubes in the 8 to 16 cell stage of development.

The fourth method, which appeared equally good, but one with which very few experiments have yet been made, was to inject the cow with P.M.S. at the same time as the corpus luteum was squeezed out at mid-cycle. To obtain success it is necessary not only for a large number of eggs to be shed, but also that all these eggs should be capable of fertilization and proper development; and considerable progress has been made in this direction. One of the causes of failure in the early trials was the transplantation of eggs whose vitality had been upset by the treatment given.

The next problem is to be able to obtain the fertilized eggs of the cow without having to kill her. For this purpose Rowson and Dowling (4) have invented a long rubber two-way tube which is inserted through the cervix into the upper end of the uterus some five days after the cow has been inseminated and when the eggs in the morula (many-cell) stage are to be found in this position. They are then flushed out by irrigation with cow blood serum, a medium which does not injure the egg. Of five attempts which have been made with this instrument, the egg has been recovered in three cases. An improved instrument is now being produced. The egg is heavier than the blood serum and settles down to the bottom of the vessel in which it is collected. Under the microscope the egg (of pin-point size) can be sucked up into a "heifer inseminating tube" in a small quantity of the serum. It can then be inserted through the cervix into the upper end of the uterus of the host cow by the same method as is used in artificial insemination. Such host cows should be at the same stage of the cycle as the donor cow from which the eggs were taken, namely, at about five days after heat.

Practical Value Now let us consider the possible ways in which this operation of egg transplantation in the cow, if the technique can be perfected, could be of use in the cattle industry of this country. It is now generally recognized that the old proven bull (that is a bull which has bred a number of high-producing daughters) is the corner-stone on which breeding for high milk and butterfat production must be based. The number of these bulls available, however, is at present limited, and the problem is how to breed more of them. Work in New Zealand has shown that the best way to do this is to mate these proven bulls with old proven cows, that is those which have a lifetime record of production and which have themselves bred high-yielding daughters. Unfortunately many of these old cows will persist in having heifer and not bull calves. If these old proven cows could be made to produce a large number of eggs and after insemination with an old proven bull, these eggs could be transplanted into other cows, the chances of getting bull calves from them, and so of breeding bulls which are likely to breed well, would be greatly increased.

THE POSSIBILITY OF ARTIFICIAL PREGNANCY IN CATTLE

One of the major cattle problems of this country, which increases in importance with the passing of time, is how to breed within the confines of these small islands all the beef as well as all the milking stock we require. Hence it is that the dual-purpose cow has always been the most popular in this country. Critics say, however, that this type is not the most efficient for both purposes, and thus the breeder of such cattle is faced with two problems instead of one, so rendering his task more difficult. The perfection of a method of egg transplantation could solve this problem. The keeping of a large number of pure beef cows for producing beef-bred calves for fattening is not possible in the small area available in this country, where so many cows have to be kept to supply us with fresh milk. If in the dairy herds of this country, the cows not wanted to breed replacements for the dairy herd could be used as incubators for pure-bred beef calves, we should have at our disposal plenty of well-bred young stock for beef production purposes. While the insemination of dual-purpose dairy cows from a colour-marking beef bull has and will supply better quality beef animals than we have had in the past, yet there are a considerable number of cows of extreme dairy type from which, even with the use of a colour-marking beef bull, it would not be possible to breed satisfactory beef calves. The number of such extreme "dairy type" cows has been increasing in the south of England recently, but it should be possible to obtain from them pure-bred Aberdeen-Angus calves for beef purposes when the process of egg transplantation in cattle is perfected. Since experiments are now proceeding on this problem in various parts of the world, there is a reasonable chance that this time may not be too far distant.

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FARM HORSES STILL ESSENTIAL

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STATISTICALLY it is possible to prove that the farm horse is an anachronism. A pair of horses will plough scarcely 1 acre a day; a medium-powered tractor will easily accomplish 3 acres. A horse consumes, so it is said, the produce of 2 acres of oats and 3 acres of grass (pasture and hay) in one year; a tractor requires no farm produce, although admittedly about 1 gallon of fuel oil, per working hour, all imported. Realistically, however, England cannot be regarded as just one large farm ripe for complete mechanization. Actually it is an agglomeration of farms of all sorts and sizes, many of which, for obvious reasons, cannot make full use of power-operated implements. Most of them are relatively small, say about 150 acres, with not more than 100 acres arable. Formerly, such a farm will have been worked by four or five horses, rather less than the power of an ordinary tractor. But this does not mean that the possession of a tractor enables the farmer to dispense with all the horses. Scarcely any farm, certainly not a small mixed farm, with its variety of overlapping jobs embracing stock as

well as crops, can manage with one tractor unaided and more than one will rarely be justifiable. At least two horses will have to be retained. As was to be expected, numbers have indeed fallen greatly in the past ten years. In England and Wales in 1939 the number of horses of working age on farms was 548,000; in 1949, 335,000. The comparable figures for tractors were, respectively, 50,000 and 231,000.

The horse's food requirements, previously referred to, seem to be based on pre-war conditions when horses, in most cases, did all the hard work. On the small, mixed farm, nowadays, the tractor does the ploughing and the heavier cultivations—jobs in which greater power and speed can be used to the best advantage. Lighter, and often simultaneous and complementary tasks, are assigned to the horses. In many parts of England they mostly lie out all the year round, subsisting chiefly on grass of which, as a rule, there is enough and to spare. Few farmers can gauge to a nicety how many "productive" stock their summer pasture can carry. The error on the safe side will usually be enough for a couple of horses. In winter they will have free range almost to themselves and need helping out with hay, as a rule, only in frost or snow. They need little or no attention at weekends, and even the expense of shoeing can often be dispensed with. Nor is there, now, the same need for skilled horsemen, since many of the jobs performed by horses, e.g., at hay-time and harvest, are manageable by lads or land girls.

Horse and Tractor are Complementary The tractor's most important function is to enable the farmer to get "on top of his work," especially at such critical periods as seed-time and harvest, when to be late is commonly fatal to success. And in farming, if you do one thing late everything that follows is likely to be late also.

"All things come to those who wait".
(I say these words to make me glad)
But something answers, soft and sad,
"They come, but often come too late".

Stubble cleaning and autumn ploughing are essentially jobs for the tractor. The ground may then be too dry and hard for horses. Seedbed preparation and drilling are also done more quickly by tractor. But later in the season, when the ground is wet, a tractor may cause too much compaction. In such circumstances horses are more suitable for applying the finishing touches. In a wet autumn horses are also better adapted for hauling potatoes, sugar beet and mangolds off soft and sticky land. And throughout the winter all carting, except road transport, is more suitably and efficiently performed by horses. Foddering outlying cattle with a tractor takes two men, one to drive, the other to unload. One man with a horse will do the job equally well.

In spring, while the tractor will be doing the heavier cultivations, a horse will be hauling the fertilizer distributor, and now that fertilizers are likely to be used more widely on grassland, he should be fairly busy for some time. Roots are often drilled by horses and are best hoed by them, especially the first time. A horse, a man and a boy, with an ordinary steerage horse-hoe, will deal with five rows of sugar beet at just about the same speed as a tractor and two men, and do it more efficiently. Mowing is still well within the capacity of a pair of horses, although, with a tractor, there is the advantage that the job need not be tackled until the dew is off the grass. Haymaking or harvest with just one tractor and no horses would be a tedious operation. A tractor can do only one job at a time. While it is mowing, horses can be swath-turning or raking. Similarly, while a tractor is sweeping,

a horse can be mowing, or raking up behind. When carting home either hay or corn, horses and tractor again need to co-operate if the work is to be done expeditiously. The tractor hauls the loads home; one or two horses shift the trailer in the field until it is loaded.

Horses and tractor are complementary and work needs to be apportioned to make the best and most economical use of both. The small farmer, having bought a tractor, is sometimes inclined to run it about the farm on every possible occasion, forgetful of the fact that when doing next to nothing or standing still it costs nearly as much in paraffin and oil as when developing full power. The tractor should enable him to intensify production, to plough up more grassland, perhaps introduce new crops. Ploughing-up is no longer the nightmare it used to be when only horses were available to tackle the wireworm. By timely and thorough cultivations and its own weight, the tractor has so improved the structure of the seedbed that the plant is now able, as a rule, to resist the attacks of this pernicious pest.

What of the future? "Heaven from all creatures hides the book of fate." We can only guess, but it is well to be prepared as far as possible for all eventualities. True, there are large farms, here and there, designedly cropped and equipped so as to be independent of horses. But the ordinary mixed farm, and certainly the small mixed farm using only one tractor, cannot be efficiently and economically run without horse aid. Horses are needed to supplement the work of the tractor at busy seasons, to replace it when the going is bad in winter and to enable the requisite staff to be, as far as possible, fully employed on productive work. It should be borne in mind that a tractor fitted with spade lugs, essential under certain conditions on land, may not be used for road work and if changed to rubbers may fail to grip on soft ground. Not all parts of a farm are, as a rule, approachable without debouching on a public road.

As to the future, this is what Mr. John Cumber, who knows his horses and uses them in conjunction with tractors on 1,800 acres, says: "It may be that the time will come that our very life will depend on the horse, but if and when that time comes it may be too late and the horse may not be there. It is said that it takes as long to produce a beefsteak as it does to build a battleship. Let us remember that it takes just as long, or even longer, to produce a horse capable of doing a day's work."

IMPROVING THE QUALITY OF THE HAY CROP

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THE days when we could import and use in unlimited quantities animal feedingstuffs such as protein-rich oil seeds, maize and other cereal grains, besides their many by-products, are now only a memory. Those were indeed spacious days for the feeders of livestock. While feedingstuffs were coming freely and cheaply into the country, the quality of hay produced on our own farms was not of great importance. Or at least that is what it seemed, for no one became despondent when bad summers came along and left us with ricks of poor quality hay.

Today, things are much different. The pattern of our agriculture is altered; no longer have we the free range of the world for animal feeding-

stuffs. Supplies from overseas are curtailed; in fact some sources have dried up completely. Home resources, therefore, have to be utilized to the full to provide more and more of the food for the increasing numbers of livestock our farms have to carry. Equally vital is it for us to do whatever is possible to improve the quality of these home-grown foods. This applies especially to hay. Nowadays there is no reasonable excuse for making indifferent hay.

Fortunately, most parts of these islands are favoured with a climate ideally suited to growing grass of the finest quality, but we have been slow to take advantage of this fact. As time goes on, however, and more and more of the old, worn-out, low-productive grassland is ploughed and reseeded to first-class leys, the dividend will be paid in the form of better yields of herbage. And not only better yields, for given proper management and fertilizer treatment, leys should be capable of providing herbage of the highest nutritive value.

Good grass demands good methods of conservation, otherwise, its nutritive value will be largely wasted. Artificial drying and silage-making retain the greatest amount of nutrients per unit of dry matter in the grasses and clovers because both methods are nearly independent of weather; haymaking is not. Our climate, excellent though it may be for the growing of grass, can be exasperatingly fickle when haymaking time draws near, as, indeed, farmers everywhere know to their cost. The weather bogy in haymaking is one that will not easily be laid. What steps ought we to take, then, to ensure that adverse weather does not spoil the hay crop or seriously reduce its nutritive value? And what methods ought we to use so that the valuable, leafier-type of grasses and clovers, which are the basis of good leys, are properly conserved in the hay? But before we go on to discuss these questions let us be quite sure that we understand what we mean by the word "quality" as applied to hay.

Factors which influence Quality In some minds good hay is identified with good weather conditions at haymaking time, that is to say, hay is described as "good quality" if it happens to have been made in good weather. No one will deny that weather is an important factor, but perfect weather never yet made good hay out of poor material. The nutritive value of hay is determined by the stage of growth at which the herbage is cut, the botanical composition of the sward, the efficiency of the haymaking processes and, of course, the weather at haymaking time. Of these, the stage of growth overrides all others, and it is useless to expect first-rate hay unless the herbage is cut early, i.e., before it develops too much fibre. As fibre increases, the amount of digestible material decreases, and it is only material which can be digested that is of nutritive value.

Digestible nutrients are present in greatest amount when the grasses are at the pre-flowering stage; thereafter, the amount steadily decreases. The fall in digestibility is mainly the result of progressive and complex changes which the fibre undergoes as the plant gets older. The fibre in any young, immature herbage plant can be digested easily by ruminant animals, but, as the plant grows, it needs more and stronger fibre for mechanical support—the fibre can be likened to an internal scaffolding supporting the plant. By the time the late hay stage is reached, the fibre has become woody and other constituents, such as protein, have become embedded in its complex structure. The result of all these changes as they affect animal nutrition is that (*a*) the woody fibre, being resistant to the digestive juices, is itself only partly digested and (*b*) it obstructs the digestion and utilization of other nutrient matter which it has encrusted. This must not be taken in any sense to imply that fibre, of itself, has no value in animal nutrition; fibre has well-recognized functions

to perform which need not be discussed here. The point to bear in mind is that most present-day rations have already more fibre than those of ten years ago, and there are no grounds for producing hay just to provide fibre.

The amount of dry matter per acre continues to increase up to the time of seed formation in the grasses, and the excuse usually given for delaying haymaking is the need to secure this increase. Extra dry matter per acre is obtainable in this way but it is largely fibre, so that this extra dry matter often means a lower yield of digestible nutrients. Other changes take place with advancing maturity of the herbage, but these in no way enhance its nutritive value or that of the hay which may be eventually made from it.

Botanical Composition of the Sward Let us now consider the influence of the various herbage species which make up the average field to be cut for hay. It must be appreciated that it is the leaves of grasses and clovers, not the stems, that are the valuable parts nutritionally. The leaves contain most of the nutrients such as the proteins and soluble carbohydrates, together with minerals such as calcium, phosphorus, potassium and the no less important trace elements—manganese, cobalt, copper, iodine and others. The stems and flowering stalks contribute mainly fibre and are, in the nutritional sense, of less value. It is therefore evident that where a sward comprises mainly herbage-species having a high ratio of leaf to stem, the hay made from it will be more nutritious than hay from species in which the leaf-to-stem ratio is low.

An old idea which persists in some minds is that the hay ought always to contain the seeds of the grasses. Unfortunately, the seeds are disseminated during haymaking operations, so their nutritive value is lost to the animal. The leaves of clovers and other leguminous plants are richer in protein than are the leaves of grasses; moreover, they contain some two to three times the amount of calcium. Hence, these plants impart quality to hay by increasing its content of protein and calcium. Some leguminous species—lucerne for one—have tough, woody stems which retain moisture tenaciously. This is a disadvantage because the leaves dry before the stems, and, being fragile, break off easily during haymaking.

Of the plants other than grasses and clovers which occur in grassland, it is known that some are harmful in one way or another to the health of livestock. It should not be assumed that plants known to be harmful are any less so when made into hay. Speaking generally, animals, when grazing, will avoid the harmful plants, but avoidance is not so easy when the plants are present in hay. Poisonous plants, as well as those suspected of having harmful or undesirable properties, are well described by H. C. Long(1).

Certain other plants, while being in nowise injurious to livestock, can be a nuisance when they occur abundantly in hay fields. A case in point is ribwort plantain (*Plantago lanceolata*). This plant is hardly ever absent from old meadows or pastures, and experience shows that when hay contains much of it, there is a risk of excessive heating in the rick. For this reason, ribwort has earned for itself the forboding name of "Fire Grass" in many localities. It is never an easy matter to decide whether the leaves are really dry, or whether moisture will "come back," thus giving rise to the danger of a hot rick. Some plants of grassland are credited with medicinal value or are thought to be beneficial in some subtle way to livestock. This may be so, but the composition of individual plant species is not known in sufficient detail for it to be said what, if any, special qualities they may impart to hay.

It should be repeated, however, that whatever the sward may contain in the way of grasses, clovers and other flora, it is always the *stage of growth* at

Photos: *Musidgraph*

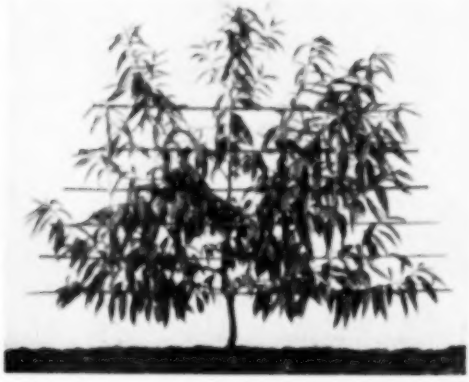
Top: Harvesting hay with a roto-baler.
Bottom: Haycocks in an Essex meadow. In former times the practice of cocking extended much further south than is the fashion today.

The Peach as an Orchard Tree

Left: A half standard tree on plum rootstock in Hampshire.
Right: A full standard.

General layout of a peach orchard in Hampshire.

A fan-trained peach tree in the nursery, showing method of initial training. This type of tree is used for wall culture and under glass.



Photos: *Laxton Bros. (Bedford) Ltd.*

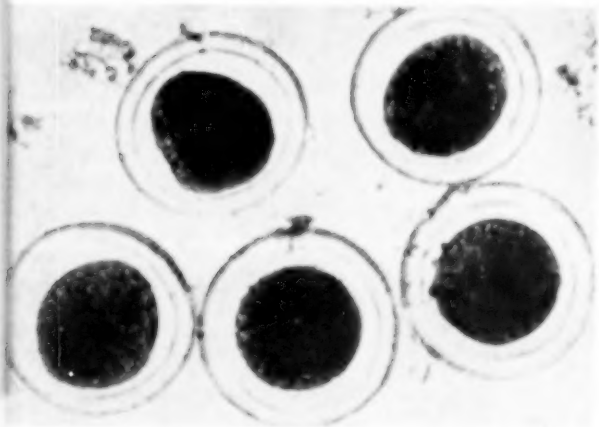
Part of the Plasnewydd herd at milking-time.

Right: Plasnewydd Lament R.M.L. by Terling Apache R.M. Has already given 56 tons of milk. Dam of two high-yielding daughters.

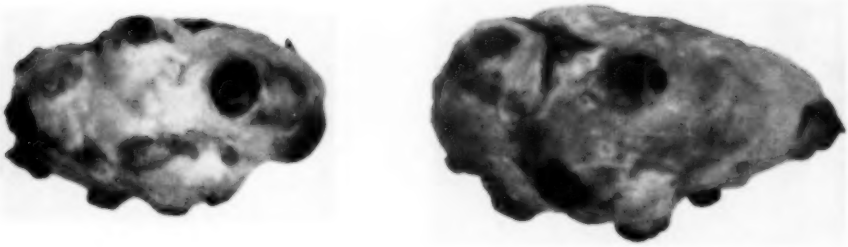
Left: Plasnewydd Broomstick R.M. by Steeple Aafrol P.I.R.M. out of a cow by Terling Apache R.M. Has given 16,156 lb. (3.94% B.F.) first calf and 16,295 lb. (4% B.F.) second calf.

Photos, *E. G. E. Griffith*

1. Two litters of rabbits produced from the fertilized eggs of albino donor does (previously mated with an albino buck) and transplanted into the black incubator does which gave birth to them (from Dowling).



2. Five cow eggs, as seen under the microscope out of a batch of nine shed at one heat period after the cow had been injected with pregnant mare serum hormone (from Hammond Jr. and Bhattacharya).



3. The ovaries of a cow which had been injected with an extract of horse pituitary gland and which had shed 25 eggs (each point of shedding marked by a red projection, the newly-formed corpus luteum) (from Dowling).

which these are mown that is, in the long run, the overriding factor for quality.

Haymaking Methods and the Weather Hazard It is undoubtedly true to say that in Scotland and the northern counties of England greater care is taken of the hay crop than elsewhere in the British Isles. For instance, in Scotland it is the normal practice to build partly-cured hay into large pikes; in most of northern England cocks replace the pikes. In former times the practices of piking and cocking extended much farther south than is the fashion nowadays, and indeed may have been general over most of the country. In the southern counties of England, piking, cocking and similar operations have largely been discontinued, the practice being to cure the hay in swaths and windrows. It is then either swept direct to the rick or some form of pick-up is used to gather the hay. Pick-up balers are gradually replacing the old motor-car or tractor sweeps, but even so the hay is cured whilst in the swaths or windrows, and only few farmers use tripods, cocks or hurdles.

There is much to be said in favour of curing hay in the swaths, and when weather permits there is probably no easier method. It is when rainy spells intervene that the swath loses all its advantages, for then much damage and loss can occur, especially if the swath has been turned and the hay is almost cured.

		Tavistock Medium-High Rainfall Area		Cullompton Medium Rainfall Area		Cheltenham Low Rainfall Area	
Approximate Average Annual Rainfall 1881-1915		48 inches		35 inches		26 inches	
		June *in.*	July *in.*	June *in.*	July *in.*	June *in.*	July *in.*
Average Rainfall	1921-46	2.70	3.93	2.06	2.69	1.76	2.35
Rainless days		No.	No.	No.	No.	No.	No.
Average number	1921-46	17	14	18	15	19	18
Actual number	1946	12	19	7	19	10	23
	1947	14	16	13	19	16	16
	1948	10	16	11	18	13	21
	1949	22	18	25	24	26	27
"Spell"-days							
Average number	1921-46	13	10	15	12	16	13
Actual number	1946	7	15	3	14	3	22
	1947	7	9	9	13	13	9
	1948	9	13	10	12	6	20
	1949	19	14	24	24	26	27
No. of years with 10 or fewer "spell"-days in June and July during 1921-49		13	15	9	11	7	11

Table compiled from Meteorological Office data by permission of the Director of the Meteorological Office.

Swath-curing of hay is in the nature of being a gamble with the weather. Let us suppose, for example, that by this method three consecutive dry days are needed to cut, cure and carry the hay from any given area in prime con-

dition; in June, in south-west England, this is the minimum period of favourable weather required.

The foregoing table sets out some statistics for June and July for the years 1921–49 and gives the number and distribution of *rainless* days (a rainless day is a 24-hour period during which not more than one-twohundredth of an inch of rain falls). Haymakers are, however, more interested in those rainless days which fall in sequences of "spells" than in the actual number, and the table also gives the number of "*spell*"-days (i.e., the number of dry days in the month which occur in sequences of at least three such days).

It will be noted that during the period 1921–46, June provided a greater number of "spell"-days than July, although in 1946, 1947 and 1948 the trend was reversed. Haymaking, at least in the south-west, was generally seriously handicapped by the weather in June, 1946, and again in June, 1948. If then, on the basis of this experience we assume that ten or more "spell"-days per month are necessary for the satisfactory swath-curing of any appreciable acreage of hay, we find that only about one-half of the months of June and July would be adjudged favourable in the "medium-high" rainfall districts, whilst between one in four and one in two of these same months in the two drier districts would be considered unfavourable.

Early Cutting is Essential to Quality

In favourable seasons in the southern half of England haymaking usually begins early in June, though perhaps the "seeds" may be mown towards the end of May. Early June hay is generally considered to have the highest feeding value, whereas July hay, being made mostly from older and more stemmy herbage, has a much lower value. But young leafy herbage is the most difficult type of all to make into hay by natural drying, even when the weather is ideal, and extra care is required with this immature type of herbage.

The main difficulty, as most farmers know, is not so much the actual removal of moisture as the fact that moisture "comes back" after the hay is apparently dry enough and fit to stack. No harm is done if this takes place while the hay is standing in cocks or on tripods, but if the hay is stacked without ventilation, (e.g., in a large rick) heating is certain to occur. A moderate rise in temperature is probably beneficial, but any excessive development of heat causes a loss of dry matter and depresses the digestibility of nutrients. Thus we are led to consider other methods which would be more appropriate to the curing of this type of herbage.

Of the methods available, it would appear that "barn drying" (or "mow drying" ([4])) is the one particularly suited to the curing of early-cut, leafy herbage. With a barn-drying installation there is little need to await settled weather before starting haymaking, for, provided there are spells of drying weather of long enough duration to wilt the herbage sufficiently to load into the drier, the weather does not matter. This does not mean that barn drying is independent of weather; it is not, for naturally the humidity of the air passing into the drier is one of the important factors in the process. Hay which has been properly barn dried retains much of the natural green colour of the herbage, the fragile leaves of the clovers, with their valuable nutrients, remain firmly attached to their stems; and the loss of dry matter is low. For lucerne, and leys containing a good deal of clover, barn drying seems to merit consideration.

So far, very few farms are equipped for barn drying, but excellent hay from young, leafy herbage can be made on tripods, pikes or hurdles. Furthermore, these methods are of more general application and, given the materials, all that is required is the determination to tackle the job. The special feature of all these aids in the conserving of hay is that, provided there is

sufficient good drying weather to reduce the moisture content in swath and windrow, the partly cured herbage can be put up and safely left while other fields are dealt with. One word of warning is necessary lest it be thought that these are foolproof aids to better haymaking. As with everything else, in farming there are right as well as wrong ways of doing a job. Such is the case when building herbage on tripods, pikes or hurdles. Thus it needs some practical experience to master the correct technique so that rain does not penetrate and cause spoilage.

Late-cut, mature herbage is easier to make into hay than the young, immature sort. For late-cut hay the case for the use of special haymaking methods is not so strong, although it remains true that in unusually wet or broken weather the protection these methods afford will save a crop from spoiling or becoming a complete loss.

Saving the Leaf It has already been stressed that it is the leaves, not the stems of grasses and clovers, which are the more valuable, the reason being that they contain the nutrient matter, but this point needs elaboration.

One of the disadvantages inherent in both the natural and the artificial drying of herbage, and other crops too, is that leaves and stems do not dry out at the same rate. The stem holds moisture even after the leaves have dried and become brittle. Unevenness in the rate of drying is the most troublesome factor in haymaking, for, if the hay is stacked while the stems are still sappy, there is a danger that this will lead to a heated rick; when left until the stems are dry, the leaves are so brittle that sooner or later they break up and are lost. Shattering is more apt to occur in leaves of the clover family of plants than with grasses; hence swards which contain a high proportion of clovers, and leys particularly, need special care. It is impossible to avoid losing some of the leafy material however carefully the hay is handled, but the loss can be confined within reasonable limits by using good haymaking methods. Again, shattering and loss of leaf is most prone to occur with hay that is almost dry enough for carrying. Therefore it is at this stage of the operations that haymaking implements should be used with care so as to avoid rough treatment.

Slow drying of the stems may be overcome by a stem-crushing device used immediately behind the cutter-bar of the mower. This idea is being developed in the United States, particularly in making alfalfa (lucerne) hay and is worth a trial in this country.

It is not easy to devise ways of estimating accurately the quantity of nutrients wasted through loss of leaf due to rough handling of hay, but all agree that wastage may frequently be considerable. No implement, except the mowing machine, is entirely free from criticism; even the cow herself, in tossing the hay about while feeding, will shake off some of the remaining leafy material, leaving it perhaps to be trodden on the cowshed floor, or into the soil in the fields. Nevertheless, some idea of the losses can be gained by watching a hay elevator working. Compared with other haymaking implements, this machine works with a smooth motion and without any violent threshing of the hay; yet a pile of "chaff," consisting essentially of broken leaf and seeds, gradually accumulates beneath. This pile underneath the elevator is a visible reminder of the less obvious fact that swath turners, tedders and sweeps, by their more vigorous action, have already scattered over the surface of the field an immeasurable amount of similar material. Indeed some of the antiquated contrivances which still make an appearance annually at haymaking time suggest that the era of the bow and arrow is not yet closed after all!

IMPROVING THE QUALITY OF THE HAY CROP

There is certainly no doubt about the quality of the material which is left lying on the field after the hay has been carted away. Analyses carried out at the National Agricultural Advisory Service Nutrition Laboratory at Bristol on samples of "chaff" from elevators show it to have about twice the protein content, three times the calcium content and half the fibre content of good hay; it may also be a useful source of other nutrients.

It may be argued that as a means of conserving leys—and in fact any grass—silage-making and grass drying are superior to haymaking. This is true. Nevertheless the counter-argument is that both dried grass and silage are, or should be, made from herbage cut before the flower-heads have emerged; that is to say, at a much earlier stage than for hay. They replace protein concentrates and are complementary to, rather than alternatives for, hay. When herbage grows beyond the stage for making high-protein dried grass or silage, obviously the next best plan is to make it into really good hay.

On farms where a part of the grass acreage is artificially dried or ensiled there will be a smaller acreage left for hay, and more time to deal with it. Advantage should be taken of this fact and consideration given to improving its quality by the use of better haymaking methods.

Special Mechanized Methods Needed It may also be thought that special methods of haymaking are, by today's standards, extravagant of labour. This, too, is true. The results of the survey carried out by Roberts and Tester[3] in the 1948 haymaking season show that curing in the swath, as practised in the southern counties, calls for fewer man-hours than any of the traditional methods still favoured in the northern counties and Scotland. The solution to the problem seems to lie in the mechanization of these traditional methods. If it were possible to reduce the labour force and man-hours required for the tripod and similar methods, there is little doubt that these methods would find greater favour and would be employed more extensively than at present. A start in this direction has been made with the mechanization of piking[4] and it is hoped that further developments will take place.

There is a real need for experimental work on haymaking technique, aimed particularly at improving the nutritive value of the product and raising the general level of quality. Never in our farming past have we so needed quality in the products from our farms as we need it today. Ideas for new methods of making hay, or improving on old ones, would be a welcome sign that interest in the subject is alive. To farmers who have ideas for improving hay quality it can be said: Now is the time to give them a trial. Incentives to go all out for quality are no longer lacking. There is scope for experiment on our own farms in addition to the work which is in progress at the recognized research stations. So, let's go haymaking—in earnest.

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LARGE-SCALE GRASS DRYING ON RECLAIMED FENLAND

E. R. TURPIN

Stoke Ferry, Norfolk

IN 1939, Mr. H. O. Crouch acquired at Stoke Ferry a block of land which had lain derelict for many years. The greater part of the land was virtually swamp and was inhabited only by wild duck—and wildfowlers who were adventurous enough to try shooting them. The soil being mainly black fen peat, the first job necessary to bring the land into cultivation was to drain it. Bulldozers and drag-lines were brought in and worked to a prepared plan of dyking and main drainage, while, simultaneously, a diesel engine with a 50 tons per minute pump was installed to lift the water from the dykes into the River Wissey, which flows along the north side of the land.

As the drainage scheme progressed, crawler tractors cleared the land of brushwood, bush willows and rubbish. As each area was cleared and dried out, deep-digging ploughs turned over the matted turf, burying it deeply. Wherever a seedbed could be prepared, fertilizers and seeds were drilled. The first crops consisted mainly of potatoes, sugar beet, carrots, cabbages, and mustard for seed. Since 1939 about 2,000 acres of this land have been reclaimed and brought into production.

Before the war the surrounding area probably supplied sufficient labour for the neighbouring upland farms, but there was little surplus available for this reclaimed area. The man-power problems associated with a system of roots and vegetable farming were greatly increased in the early war years by the calls of the Services, but the position eased from 1942 onwards when prisoners of war and other gang labour could be obtained from the Norfolk Agricultural Executive Committee. With the dispersal of gang labour soon after the end of the war, it became obvious, however, that the system of root farming, with its very high labour requirement, could not be continued in the rapidly changing circumstances. Further, the demand for vegetables by the troops during the war was also diminishing. Some other use would obviously have to be found for this land.

The need for more and better grass, and its conservation by drying to promote greater self-sufficiency in animal feedingstuffs, particularly protein, supplied the answer. The first problem was to obtain an efficient grass drier of high output combined with low labour requirement, which could cope with the production of grass and other forage crops from roughly 2,000 acres of land. The majority of British-made, low temperature grass driers of the tray-and-conveyor types are designed to give an output of from 3 to 9 cwt. of dried material per hour. Whilst these British driers are satisfactory for farm and medium-sized grass drying operations, the very high labour requirement in relation to output makes them very much less attractive for large-scale drying.

Accordingly, Messrs. H. O. and D. C. H. Crouch made an exhaustive study of American grass drying plants during two visits to the U.S.A. in 1947. They inspected the Arnold Dehydrating plant, manufactured by the Heil Manufacturing Company of Milwaukee, and visited more than thirty Heil drier centres, meeting operators, farmers, labourers and others who had experience of the plant. As a result they were convinced that American technique and equipment in this sphere had most to offer on the development of large-scale factory grass drying such as they envisaged for the 2,000 acre estate at Stoke Ferry. One aspect in particular in which American

driers, such as the high temperature Heil plant, excel over batteries of small British tray-and-conveyor types of drier is in their much lower labour requirement; the saving in labour may be as much as one-quarter.

A Heil drier was installed at Stoke Ferry in July, 1948. The site chosen for the drier was in some old farm buildings just outside the village of Stoke Ferry on the main King's Lynn-Newmarket road. Fortunately, water and electricity were available, and there was a railhead 300 yards away.

From June, 1948, onwards, whilst waiting for the plant to arrive from the U.S.A., and also during the actual installation, grass seed was drilled so that there would be something to cut and dry that first autumn. Altogether 330 acres of wheat were drilled and undersown with ryegrass, so that the greatest amount of greenstuff per acre would become available in the shortest time. No artificial manure was necessary for this original sowing, as the previous root crops had received a very liberal allowance. Drying operations began the first week in September, and over 500 tons of high quality grass meal were produced that autumn with an average protein content of 21 per cent. The highest protein was 31 per cent - obtained in December.

Early in 1949 all the established grass was dressed with 6 cwt. per acre complete fertilizer, and after each cut of grass, 3 cwt. of a nitrogen fertilizer was applied. As the weather improved, the seed drills were kept constantly busy, and, in all, 1,000 acres of land were sown to grass, of which 300 acres were in Danish cocksfoot, 300 acres in New Zealand Akaroa, and the remainder in two varieties of Aberystwyth strains of cocksfoot.

Speed in Operation from Crop to Meal The method of harvesting is to cut the grass with a mower drawn by a tractor and driven by the power take-off; the cutters are followed as quickly as possible by the largest swath-turners obtainable, and then three swaths are windrowed into one row. This thick windrow of grass is picked up by the harvesting machines, which are fitted with a pick-up and a six cylinder engine to drive the chopping mechanism. The harvester carries the grass to the back of the machine, where it is cut into approximately one-inch lengths and blown through a spout into trailers alongside. The trailers are then taken to the drying plant and their loads tipped into a hopper of 6–7 tons capacity.

The Heil drying plant comprises this self-feeding automatic hopper which feeds the grass into an elevator, whence it is conveyed to the revolving drum. At the conveyor end of the drum is the automatic oil-fired furnace, which burns about 55 gallons of heavy oil per hour and is normally run at a temperature of 1700°F. At the other end of the drum a fan sucks through the heat and, of course, the grass, which is airborne throughout its whole journey. (There are actually three drums, one inside the other, rather like a closed telescope, and the material therefore travels three times the actual outside length of the drum.) The fan blows the now dry grass and steam into the top of a large collecting cyclone, out of which the steam-laden gases pass into the atmosphere and the dry material drops by gravity to the bottom. Here, a second fan sucks in cold air and snatches the grass while still in suspension, and blows it into the cooling cyclone, whence it is conveyed to the hammer mills, there to be ground into a fine meal and blown into the sacking-off spouts in the warehouse.

As the men are sacking-off the dry grass meal, care is taken to get a representative sample of the day's product. This is done by taking a handful from every tenth bag and putting it into a tin. At the end of the shift, the contents of the tin are thoroughly mixed and a small sample sent to the chemist for analysis. The tin, with the remainder of its contents, is then

put into store so that buyers may examine samples from each shift's output.

The whole plant is operated by four men only, a charge-hand who is responsible for greasing, one man tipping the trailers, and two men in the barn, sacking-off. The plant is designed to evaporate 6,000 lb. of moisture an hour, which, with an initial moisture content of the raw material of 75 per cent and leaving approximately 8 per cent moisture in the finished product, gives an output of just on 1 ton an hour.

The operation of the machine is very simple and is self-controlling, the control being situated at the outlet end of the drum and worked by the outlet temperature. If it is decided that 250° F. is a suitable outlet temperature, the gauge is set to that reading, and if, at any one time, too much grass is being fed, the automatic control immediately slows down the rate of feed and opens up the oil jets to increase the heat in the furnace. If the heat being generated is too great, the outlet temperature control immediately increases the amount of feed and reduces the amount of oil. There is no forking of heavy wet grass by the operators, and once the trailer has been tipped by the electric winch into the hopper, the grass is not touched by hand at all, and indeed is not seen until the sacking-off men remove the full sack of dried grass meal for weighing.

As already mentioned, with an initial moisture content of 75 per cent, the output of dry material is in the region of a ton an hour, and if this output is to be maintained for twenty-four hours a day, anything from 1 to 2 acres of land per hour needs to be cut, picked up and carted to the plant. It therefore becomes necessary to work all the hours of daylight, and the field staff have to be organized into shifts, one crew starting at dawn, and the last team finishing at dusk. Working in the fields at night has not been tried so far, since it is felt that this might raise difficulties. It is essential, however, that once the grass is cut it should not remain in the trailers too long; otherwise the material will start to heat. For the same reason care must be taken to see that the trailers are fed to the drying plant in the same order in which they come from the field.

A very serious problem facing everyone farming the light, black fen soils is that of blowing. In March and April a strong wind can completely destroy young seedlings by blowing them right out of the ground, together with the fertilizer, the whole being deposited either in the adjoining dykes or over the neighbouring parish. To minimize this expensive, almost annual, occurrence, most of the old leys are ploughed in the autumn and drilled with rye or winter wheat. As soon as possible in the spring these crops are cut for the drier and the grass seed drilled without delay. If a strong wind follows, the autumn-sown cereal has enough root-hold to protect the grass seed.

Last autumn a second Heil plant was installed alongside the first. A Californian cubing plant was also installed, so that dried green crops can be supplied in either meal, cube or pellet form. The cubes are made by passing the grass meal through a chamber where steam is mixed with the meal, and the latter then forced by rollers through dies under enormous pressure.

At present no binder is allowed to be added to the meal other than steam. If molasses or an oil could be used as a binding element, the output of the cuber could be almost doubled.

Spring Surplus Grass Our ultimate aim is to produce nothing but high quality grass meal. To ensure this, constant care in the management of the grass crop is needed and steps must be taken to prevent any grass from getting old. It is fairly certain that if a drying plant

operator wishes to have sufficient grass during the period July-August to keep his plant working twenty-four hours a day, he is more or less bound to have an excess in the spring period.

The surplus of grass during the 1949 season was made into silage and utilized the existing equipment. The drag-line, which is normally employed in dyking, dug four pits on the side of a hill, each about 150 yards long, 16 feet wide and 8 feet deep. This drag-line was used also for tipping the trailer loads of grass, after which the usual mixture of molasses and water was added. Several hundred tons of silage were made, and this was dried during the winter months and cubed.

Other Crops Besides the drying of grasses, green cereals and lucerne, kale has also been dried. This was harvested with the cutters and presented no difficulties at all, except that the initial moisture content is very high; the resulting product averaged about 18–19 per cent protein.

Experiments have been carried out with sugar beet tops, but the difficulties here have not yet been overcome satisfactorily. In the first place topping must be completely mechanized, and during this process the tops must not be allowed to touch the ground, otherwise they pick up too much soil; even so, the amount of silica in the finished product, especially in beets from sandy soils, is too high. It therefore seems that it may be necessary to wash beet tops before they are dried, but it does not seem a good idea to add water to a material when the ultimate aim is to extract the moisture – it makes the drying operation a far more costly process.

THE PEACH IN ENGLAND

2. CULTURE

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Part I, dealing with the historical aspect of the peach in England, appeared in last month's issue of Agriculture.

As mentioned in the first part of this article, peach culture in England has been confined almost entirely to the management of fan-trained trees grown in the open against walls or on trellises or in glasshouses. A well-managed tree had some six or eight main branches radiating from a short-stem axis, with the space between them filled with the "bearers" or fruiting growth.

It was the management and replacement of the fruiting growth which called for special skill on the part of the cultivator. The peach produces its fruit on the second-year wood, i.e., wood of the previous season's growth, and therefore it is always absolutely necessary, whatever the form of tree, that an adequate supply of new shoots are produced from year to year. With fan-trained trees, a careful and systematic routine of pruning and disbudding is observed. Pruning ensures that all growths that have borne fruit are removed, together with all coarse, thin and surplus growth of the current season. Disbudding not only ensures the production of replacement shoots where required, but prevents too much growth and waste of the tree's energy. Naturally this type of culture involved an extravagant amount of labour.

It must be admitted, however, that well-trained peach trees of this type rarely failed to thrive and yield full crops of high quality fruit for a great many years. Recently F. J. Rose (1) has stated that a fan-trained peach tree of Sea Eagle at the Townhill Gardens, Southampton, was in its 38th year of life, carrying about 250 fruits, of an average weight of 6½ oz. each.

However, from the commercial standpoint, peach production in the open by means of fan-trained trees is hardly an economic proposition, owing to the high cost of labour. The position is not the same with glasshouse culture, for with the aid of glass, even unheated glass, earlier crops, which may be more profitable, are obtainable. The main purpose of this article, however, is to consider the possibilities of orchard culture in England. In the first place a few general principles underlying orchard practice will be considered.

Orchard Soils Osmond (2), drawing conclusions from a description of Worcestershire orchard soils, described briefly the most suitable orchard soil as " . . . one in which there is no factor in the soil which will restrict trees growth and in particular, root growth. Such restricting factors are: high water-table, low water-table, impenetrable layers of weathering rock or gravel at no great depth below the surface; poor or bad drainage in the profile; wrong texture, i.e., too light and therefore droughty, or too heavy and therefore apt to be wet."

On the subject of soils for the peach, Gourley and Howlett (3) state: "This crop is most commonly grown on soils of somewhat lighter texture than is considered most desirable for apples, although the best apple soils are also suitable for peaches, within their climatic limitations." Chandler (4) states: "Among the deciduous orchard fruits only almond roots show about as little resistance to wet or otherwise poorly aerated soil as peach roots; and even among soils well enough aerated to prevent killing of roots, *some may not be open or coarse enough for best quality of fruit*." The concluding words of Chandler's statement are italicized because it is clear that (as many generations of garden-growers of the peach have known) the rooting medium has an important bearing on fruit quality. At the same time, soil nitrogen, and soil moisture to facilitate its absorbtion, are equally important factors. Although, therefore, the best quality peaches may be grown on open sandy or gravelly soils, such soils may be unsuitable for satisfactory wood growth and crop yield. It is of interest to note, in this connection, that orchard peach trees have been established satisfactorily in Suffolk on boulder clay and in Hampshire on upper greensand, in company with other deciduous tree fruits.

As regards the requirement of elements (both major and minor), Chandler mentions that the peach tree can obtain enough potassium from some soils that do not supply enough for the apple or plums of the *domestica* type. It is concluded from what is authoritatively stated about soils for peaches that nitrogen, as an important nutrient factor in tree growth and yield, should always be in sufficient supply and yet not so abundant or unseasonal in supply as to have a disturbing effect on wood ripening, fruit-bud formation and fruit quality (flavour and colour). Much of the experimental work with peach nutrition in various parts of the world has resolved itself into a matter of applied nitrogen, either as manure (or compost) or fertilizer, in association with soil treatment, including the use of soil cover crops.

Rootstocks In countries where the peach is grown extensively in commercial orchards, the peach seedling rootstock is used most exclusively. In the U.S.A., for example, fully 90 per cent of the trees are grown on peach rootstocks. The apricot, almond, and varieties of plum have been used also.

In France recently (5), experimental trials have been made with selected types of a rootstock derived from seedlings of the peach-almond—a hybrid to which Knight referred as far back as 1817. Both the plum and peach-almond rootstocks can be propagated vegetatively by layering (*marcottage*), which, probably, partly accounts for the general use of the former in England. The plum rootstocks recommended for peaches are Brompton, Damas C, Common Mussel for large to medium trees, and St. Julien A for medium to small trees. With the plum rootstocks, however, stock-scion incompatibility occurs with certain varieties: Bellegarde, e.g., is said to be incompatible with Common Mussel (Rivers). Also, the behaviour of different varieties on the same rootstock varies considerably with the soil. Of the plum rootstocks used in England, Brompton seems to give the largest and most vigorous trees, though it is not as easy to form trained trees with it as with Common Mussel, which, when compatible with variety, gives well-balanced, healthy trees for culture under glass and on walls.

The orchard peach trees illustrated are on Brompton and Common Mussel rootstocks. It is of interest to note that Mr. Justin Brooke (6), who has experimented with orchard peach culture in Suffolk, states on the subject of rootstocks: "... we have to stimulate the growth of the peach bush in order to get good fruiting, so I aim in the future to get the most compatible stock I know, namely, the peach stock."

Pruning and Thinning The fruit of the peach is borne on wood of the previous year's growth, and in this respect the peach resembles the acid cherry and differs from the sweet cherry and the plum, both of which form spurs. The peach does not form fruiting spurs. Unpruned trees will therefore tend more and more to carry their fruit on their circumference, the centres becoming bare and, with declining vigour, the amount of new wood annually produced decreasing in quantity.

A regular system of judicious pruning is therefore important. When the framework has been built up, full advantage should be taken of the tree's habit of making fresh growth from dormant buds on both new and old wood. Each year a certain amount of growth should be cut back so that a constant supply of new fruiting shoots are produced and the tree's vigour is maintained. In this there is little resemblance to the pruning of apples or pears, but those who are familiar with the principles observed in pruning acid cherries should have no difficulty in understanding the pruning requirements of the peach. In this country it is held to be inadvisable to prune orchard peach trees during the dormant period. The pruning should be done at the bud-break stage, that is, during April or even in early May.

The form of tree generally used for orchards is the bush, though where much cultivation by machinery is done half-standards, or even standards, are more suitable. The drawback of tall trees is the difficulty of fruit thinning and picking. All forms of tree are being grown in this country at present, but further experience of each is required before a firm opinion as to the best form can be given.

Initial pruning treatment varies. The tree may be restricted to three or four primary branches to form a framework, or it may be allowed a larger number; in other systems a natural branch development is permitted.

Fruit thinning is an important routine operation. It is an inflexible rule in peach culture that to obtain full-sized fruits of good colour and high edible quality, the trees should never be over-cropped. Preferably the thinning should be done in two stages, the first when the fruits are a little larger than a pea, and the second immediately after the "stoning drop" when the fruits are about thumbnail size. After the second thinning the fruits should be at

least eight inches apart on the tree. With fan-trained trees a thinning plan that leaves a fruit to each square foot of space has been the guiding principle for many generations of successful growers of peaches.

Peach Orchards The following information concerning the peach as an orchard tree has been supplied by growers in Suffolk and Hampshire.

Suffolk: Mr. Justin Brooke, Clopton Hall Fruit Farm (Soil: Boulder clay on chalk)

Apparently all varieties will grow in England, but late-ripening varieties should be avoided, as the fruit rarely gets its full flavour and sweetness if it ripens after mid-September. Hale's Early has the disadvantage of producing too little pollen, and is the only peach known to be mainly self-sterile. Early Alexander, Duke of York, Peregrine, and Bellegarde, ripening in that order, are the best, as far as experiments have gone.

Peach rootstock is outstandingly the best; the plum stocks do not give sufficient vigour. Of compatible plum stocks, Mussel is the worst, then comes Brompton and then Kroosje.

Mr. Brooke considers the *average* annual yield of marketable fruit from a mature tree to be in the neighbourhood of 300 peaches. In 1948 mature trees gave, on an average, over 500 marketable peaches.

A small hand-operated grader for peaches was made, with the aid of which 12,000 peaches were picked, graded and packed in a day. It is thought that with some alteration this operation can be speeded up to allow of an output from the grader of 50 per cent more.

Hampshire: The Lord Selborne, Blackmoor Estates (Soil: Upper greensand)

Standard and half-standard peach trees on Common Mussel and Brompton rootstocks were planted in 1942 and 1946 in an exposed and windswept situation, at an elevation of 400-500 feet with a south and south-east slope aspect.

Varieties found suitable are Amsden June, Libra, Stirling Castle, Peregrine and Rochester (a well-known American orchard variety).

The trees are manured regularly at the rate of 5 cwt. per acre meat-and-bone meal and 2 cwt. sulphate of potash. A mulch of farmyard manure is given to each tree in the spring.

No winter pruning is practised. The trees are pruned at the bud-burst stage in April or May, cutting the previous season's wood back to the second good bud.

Tree growth has been satisfactory. Good standard trees planted in 1942 are now 16 to 18 feet high; half-standards are 12 to 14 feet high.

For the control of disease (Leaf Curl is the principal malady), the trees are sprayed in the autumn at leaf-fall with a colloidal copper fungicide (3 pints to 100 gallons of water) and a second spray is given two weeks later. In February the trees are sprayed with 2 per cent lime-sulphur.

From the trees planted in 1942, the best crop was taken in 1949. In 1945 a violent wind storm stripped the trees and caused a reduction of crop both in that year and 1946. Trees planted in another orchard in 1946, bore a good crop for the first time in 1949.

NECTARINES. Little information is available regarding the culture of the nectarine as an orchard tree. Under the conditions at Blackmoor, the nectarine has not proved successful owing to the splitting of the fruits, but it is thought that if planted on a less exposed site and in a better moisture-holding soil, it might possibly succeed.

Pests Although there are species of aphids that attack the peach, there is no evidence that they cause serious damage to orchard trees. Incidentally the peach aphid (*Myzus persicae*) is a specific vector of the virus of Virus Yellows of sugar beet. Actually few insects are harmful to the peach in this country. On the other hand, two species of mites, including the fruit tree red spider, can cause serious trouble under certain conditions. Normally these mites are controlled fairly substantially by natural predators, and for this reason spraying the trees with a winter tar oil wash is a doubtful practice, as it destroys these beneficial predatory insects. If aphids appear during the spring, control can be obtained by means of nicotine or other suitable sprays. If necessary a control of red spider mites can be obtained by means of derris sprays in summer.

Summary Summarizing the foregoing information, there is evidence indicating that both the peach and nectarine should grow in the open in this country almost as readily as plums. Although flowering is early, the risk of damage by frost is not great, and the trees may not suffer as much as plums in this respect. Given suitable fertilizing conditions, the blossoms set fruits freely, and a fairly drastic thinning is necessary to obtain fruits of reasonable size.

The trees should, where possible, be grown on peach rootstocks under orchard conditions. Failing availability of this stock, Malling St. Juliana, Brompton, and Common Mussel are the best of the plum rootstocks.

Considerable care is required in pruning the peach.

Varieties that mature early, i.e., in August, are the most suitable for English conditions. Peregrine is an example of a good type of peach for orchard culture.

The author acknowledges the helpful information furnished by Mr. Justin Brooke and Mr. T. H. Rivers regarding orchard peach culture in Eastern England, and by Mr. C. H. Oldham, of the N.A.A.S., for information regarding orchard peaches in Hampshire.

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Erratum—Part 1: For *The Cherries of New York* read *The Peaches of New York*.

PASTURES FOR POULTRY

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THE problem of grassland in relation to poultry has long occupied the attention of the Nottingham University School of Agriculture, where, under conditions of semi-intensive management, the aim has been to establish and maintain a useful sward of a semi-permanent nature. Special attention has been given to the seeds mixture for poultry pens, but mixture alone is not sufficient; management plays at least an equal part in success or failure, as with any grassland enterprise. The problems connected with

folding, ranging or semi-intensive housing are so diverse that it is very unlikely that seeds mixtures found suitable for one particular set of conditions of management or soil type, will prove ideal for others. It must be stressed that these observations apply to *semi-intensive* housing of poultry, although the pens may extend, in the case of the largest, to an area of 1¾ acres. The soil is light to medium loam overlying gravel, and the rate of stocking varies throughout the year, but averages in the region of 200 birds per acre in the pens used by the breeding and laying stock.

Trial Plots It has been assumed that the consumption of good quality grass is beneficial to poultry, and with this in mind just over 15 acres of the area occupied by the poultry department have been laid down with various seeds mixtures over the last eleven years. Many of these observation plots were of a trial and error nature, for it was soon evident that species which might reasonably be expected to provide a satisfactory sward when grazed by cattle, were not quite so promising when sown in the poultry pens. In all, eighteen different seeds mixtures have been used, and the majority of these have been replicated in plots varying in size from approximately 136 square yards to over 2,200 square yards. Observations have been made on the changes which occur in the botanical composition of these swards over a period of years and attempts made to evaluate each species, by observation, on such characters as palatability, durability, persistency and seasonal productivity. It hardly needs mention that these four characteristics are the desiderata of any species considered for inclusion in poultry seeds mixtures: palatable to be of real value; durable to withstand the effect of scratching; persistent to avoid deterioration of the sward and the necessity of frequent reseeding; and capable of producing fresh growth at the time of year when most needed. No really ideal species, combining all these virtues, has been discovered but some show promise, whilst others can be dismissed as useless for the particular purpose of semi-intensive runs. A mass of data had been accumulated and in March, 1948, it was decided to sow a series of small observation plots of pure strains of the following twenty strains and species of herbage plants:

Irish perennial ryegrass
S.23 perennial ryegrass
S.24 perennial ryegrass
S.143 cocksfoot
S.48 timothy
S.50 timothy
S.53 meadow fescue
Rough-stalked meadow grass
Smooth-stalked meadow grass
Annual meadow grass
New Zealand browntop
Fiorin
S.59 creeping red fescue
Chewing's fescue
Irish crested dogstail
Kentish crested dogstail
S.123 late-flowering red clover
S.100 white clover
Kentish Grade A wild white clover
Ribgrass

Each plot was duplicated and the whole experiment laid down in a double breeding pen of 272 square yards. The trial was also arranged in such a way that the species nearest to the house in one section were farthest away in the other. Such a small-scale experiment was not expected to provide conclusive evidence on its own, but to reveal more detailed information than could be gathered from large-scale observations and, in particular, to afford a close study of the reaction of the fowl to the individual strains and species. We believe that a close study of the grazing behaviour of all animals is fundamental to the solution of many grassland problems.

The conclusions established in previous years were, in the main, confirmed by these close observations, which, incidentally, were carried out for continuous periods of usually up to three or four hours at different times of the

day, periodically throughout the year and occasionally up to ten hours in the course of a day. A summary of the general impressions gained from observation on both large- and small-scale plots is recorded below.

Results of Observations The species which were never grazed appreciably by poultry were Chewing's fescue, S.59 creeping red fescue, fiorin and browntop; and all four, although not so much S.59 red fescue, had the added disadvantage of winter-burning and becoming "feggy" during late autumn until well into spring—a time when grazing could have been extremely valuable for breeding stock running in the pens. It was observed, however, that geese grazed Chewing's fescue on the smaller plots quite readily during early summer.

Of the remaining grasses, all were eaten to a greater or less degree, varying with the time of year. This grazing proved to be an integral part of the hen's daily activities, particularly first thing in the morning and in the late afternoon—and this despite the fact that they were receiving from 5 to 10 per cent high quality dried grass or lucerne meal in the ration. Although statements have been made to the contrary, poultry of all classes and all ages proved good grazers to such an extent that palatability was given first priority in the evaluation of a particular strain or species. It must be mentioned that every effort was made to keep the herbage short to avoid complications due to length and fibrosity, and in this connection sheep were used to graze the plots from March to November, and geese as required throughout the year. Incidentally, the sheep proved quite as fastidious in the choice of herbage as did the poultry.

Annual meadow grass was the most popular grass with poultry, but it has to be ruled out, owing to its annual habit and the uncertainty of seed supplies at the present time. It was closely followed by rough-stalked meadow grass, particularly during late autumn, winter and early spring when the short green leaves were eagerly grazed by breeding stock. This species, however, was susceptible to drought and made no material contribution on our light soil during summer. Smooth-stalked meadow grass was also palatable, but under our conditions it was not so successful during the November-February period. It did, however, withstand scratching much better than rough-stalked meadow grass, and it is suggested that both these species are of great value.

Crested dogstail, although neglected during summer, was grazed eagerly during the winter, but this species proved intolerant of our conditions and, where sown in mixtures, disappeared almost entirely in the second and third years. It may be that on heavier soils this grass would prove very satisfactory.

Of the perennial ryegrasses, S.23 proved most valuable and, when controlled by sheep during the summer, in no way became coarse as many have claimed. S.23 seems the only perennial ryegrass, of those available in appreciable quantities, to be worthy of consideration, and it is felt that, of the species tested, S.23 must still remain the basic ingredient of mixtures for semi-intensive runs. Neither S.24 nor Irish commercial ryegrasses were sufficiently prostrate to give a close sward.

S.53 meadow fescue (sown in the small plots only), although wintergreen, was not eaten to any appreciable extent. This grass tends to grow tall and coarse in poultry pens, and its open sward suffers considerably from poultry scratching. Similarly, S.143 cocksfoot, even when sown thickly to avoid tuftiness, was not favoured, although when the poultry had no alternative, they did eat it, but never eagerly. The timothies S.48 and S.50 were most valuable, particularly the latter with its denser and more prostrate habit.

Besides being eaten with avidity, S.50 presented an almost lawn-like sward, and it was thought that this grass would provide the answer, but unfortunately it failed badly in mixture with wild white clover, when early winter scratching resulted in a very "pot-holed" sward. It is, however, well worthy of inclusion in the mixtures, but according to our results to date it should not be used alone. A common belief that timothy is suitable only for heavy land has long been dispelled by agriculturists, and our observations confirm the value of this species for poultry runs under light land conditions, such as exist here.

Ribgrass (*Plantago lanceolata*) was tried in the small plots with emphatically negative results. It was thought that the poultry might appreciate herbage of an entirely different nature, but this did not prove to be the case. This plant, by nature of its rosette habit, presented a very open sward, totally unsuitable for poultry.

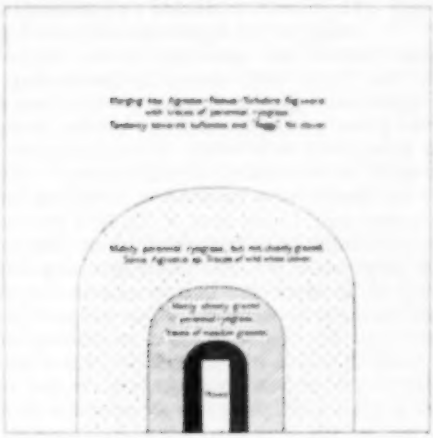
Popularity of Clovers The clovers presented a particularly interesting study, owing to the eagerness with which poultry devoured them. In the small plots it was necessary several times to fence off the clover plots to protect them from complete destruction. This was particularly so when geese were grazing the plots, and it was noticed time and time again that the geese would not eat any of the true grasses until the clovers had been completely defoliated; and occasionally geese were observed eating the ends of the stolons of white clover. Continued grazing with geese would no doubt have resulted in complete elimination of the clovers, which occupied only 15 per cent of the area devoted to small plots. On this evidence, combined with that obtained by observation of grazing poultry on a fairly large scale, it seems imperative that a liberal seeding of white clover should be incorporated in any mixture for poultry, and that every effort should be made to maintain a fair proportion of clover in the sward. Owing to its greater vigour, S.100 is recommended, but wild white clover should be selected where it is intended to leave the grass down for several years. Red clovers proved unsatisfactory, as they produced a sward much too open for poultry and were never so palatable as the white clovers. In addition, they are, of course, not so persistent.

Suitable Mixtures Since no one grass has been found to fulfil the requirements of palatability, durability and persistency, it is felt that a mixture of several species, combined with a fairly liberal seeding of white clover, will give the greatest satisfaction under semi-intensive conditions to stock of all ages. The following are two such mixtures:

	Mixture No. 1 *lb. per acre*	Mixture No. 2 *lb. per acre*
S.23 perennial ryegrass	14	12
S.50 timothy	—	9
Rough-stalked meadow grass	12	7
Smooth-stalked meadow grass	7	4
S.100 white clover	1	1½
Wild white clover	½	1
	34½	34½

Mixture No. 1 has been used and recommended in the past, but in the light of further investigation, we are inclined to suggest that Mixture No. 2 will prove even more satisfactory. The total seeding rate may seem rather

high, but it is felt that only under ideal conditions can this rate be appreciably reduced. Under good conditions Mixture No. 2 should provide a dense and persistent sward, highly palatable and reasonably durable. Management, before and after the establishment of the sward, presents the major influence on the value of such grassland. At Sutton Bonington nearly all the adult stock have two runs which can be grazed alternately, and the period of rest allows the better grasses to maintain their dominance. The gradual suppression of the better grasses by volunteer fescue and agrostis species seems associated with lighter and continued stocking under our conditions. Around the stationary houses, in larger pens which have been down to grass for several years and where stocking has been continuous, except that pens are used alternately, a marked zonal effect can be observed.



The zones are very distinct but merge into one another. In summer the bare ground around the house is colonized mainly with annual meadow grass.

This zonal effect affords an interesting ecological study of grassland in relation to poultry, and points to the tolerance and value of perennial ryegrass. The areas distant from the house are admittedly well covered, but the Agrostis-Fescue-Yorkshire fog sward is rarely utilized by the birds for grazing. It seems that certain areas are selected for grazing, and the only species which tolerates the more severe treatment is, in the main, perennial ryegrass. Acidity plays no part in this zonation as adequate dressings of lime are applied periodically.

The problem of grassland under conditions of semi-intensive poultry-keeping is complex, and whilst it is relatively easy to maintain an attractive sward during late spring and summer, catering for heavy stocking from November to March is a far greater problem. It is by no means claimed that this problem is solved and work will continue with, it is hoped, particular emphasis on the management of such grasslands.

TWENTY-FIVE YEARS OF "WATSON AND MORE"

IT is probably true to say that the last twenty-five years have witnessed a progress in British agriculture more far-reaching and of greater moment than at any other period in our history. Throughout this quarter of a century "Watson and More"—no one dreams of referring to this well-known textbook by its published title—has served the land in both the scientific and practical spheres, and served it well. To balance science and practice in farming is never easy, but the authors in their original work achieved a high measure of success, and since that time each edition has kept pace with progress and has mellowed with use, until the present edition is a near approach to perfection. The untimely death of James Anthony More in 1947 dissolved a happy partnership with Sir James Scott Watson which had lasted twenty years and covered eight editions of this book. Sir James, who has been assisted by Mr. W. J. West in the present edition, pays a tribute to the value of More's notes compiled during the last year of his old friend's life.

The task of reviewing the new edition* is an extremely happy one, for there seldom comes the chance of appraising a book in which one has such supreme confidence—a confidence proved by the passage of time and by the comments of countless readers to be well merited. To glance back at the first edition and then compare it with the ninth, gives one a very clear picture of agricultural progress in the last quarter of a century. Twenty-five years ago, a reviewer of the first edition expressed the opinion that it was likely to have a useful life as a text-book for students and as a general guide for farmers. That view has been abundantly confirmed, and there can be few students during this period who have not made use of its information. Those pessimists who try to spread their despondency over British agriculture, and who are forever saying that other countries are ahead of us in development, might well spend a few hours comparing the two editions. Who could have envisaged twenty-five years ago, for instance, the development of compound fertilizers as we know them today—and national compounds in particular? The placement of fertilizers was then in the very early experimental stage, and few appreciated the tremendous importance of trace elements in plant nutrition. These matters are all described in their respective chapters. The section on implements and cultivations again indicates the enormous strides that have been made in mechanization in the last twenty-five years. Then, the age of steam cultivation was just passing, and the tractor was only just coming into its own. Now, in the new edition, the illustrations in this section indicate how the multiple-furrow plough is part of our normal equipment, and how the introduction of the hydraulic lift has revolutionized farm equipment in general. Another striking development, of course, has been the use of the new weed-killers, the DNOC and hormone types, contrasting greatly in efficiency with the general recommendation twenty-five years ago to use copper sulphate or calcium cyanamide.

Great development, too, has taken place in the sphere of harvesting crops. Twenty-five years ago, the combine harvester was thought suitable only for the vast ranches of America and Australia, yet in the present edition it takes its place beside the binder as part of the equipment of British farms. Likewise, the illustration of the forage harvester at work occasions no great excitement, nor does the pick-up baler, or potato and sugar beet harvesters. This revolution in British farming has taken place so gradually as to seem, like Topsy, "to have just growed". The chapters on crop varieties, wheat, oats, barley, and the various root crops, have been brought up to date, and the

* *Agriculture : The Science and Practice of British Farming*. (Ninth Edition) James A. Scott Watson and James A. More. Oliver and Boyd. 26s.

recommendations are in line with those of the National Institute of Agricultural Botany.

In the livestock section of the book, as one would anticipate, there are no really striking changes to be noted between the first and the latest edition. Livestock improvement is a slow business at best, and the basic principles do not change from year to year; nor for that matter have the principles of feeding changed markedly in the last quarter of a century. There is an emphasis today on home-grown food and self-sufficiency, and the quest for protein is constantly before us.

The chapter on the principles of nutrition particularly merits favourable comment as an example of how this most difficult subject can be dealt with concisely and clearly. One notes in the chapter on milk production the influence of changing ideas in buildings and methods, and this chapter has been brought into line with modern thought on the subject.

The main plan of the book remains unaltered, being divided into four sections: I. The Soil and its Management; II. Crops; III. Farm Livestock; and IV. Farm Organization and Management. The last named—Farm Organization and Management—is perhaps the most vital section in the book, and here the prospective farmer, the student, and indeed the established farmer, can with profit spend much time in study. A chapter is devoted to the choice of farm enterprises, and examples are given based on reasonably up-to-date prices, indicating the annual expenditure and income that may be expected from various systems of farming. This has always been one of the most valuable chapters in "Watson and More," and in the new edition there is much to ponder.

The appendices are very complete, giving the tabular information frequently required for reference purposes in the everyday work of a farm. The inclusion of agricultural statistics for the United Kingdom for 1939 and 1948 is a thoughtful provision.

What can one say about such a trustworthy friend? With the passage of time each new edition seems to grow in stature, as in size, and contained within its 943 pages is the very essence of British farming today—an essence, but not too concentrated, and a work which can be recommended without qualification to every agricultural student, to every prospective farmer, and to every farmer who wants to have a most reliable work of reference constantly at hand. The number of illustrations has been increased and brought up to date and maintain the same high standard; the essential data for general use is well tabulated, and at 26s. this book is excellent value. Those whose bookshelves have always housed "Watson and More" must find room for the new edition: for students it is essential, and for practitioners it is their bread and butter.

H. IAN MOORE

FARMING AFFAIRS

Rations of Feedingstuffs for Livestock : Summer 1950

As stated by the Minister of Agriculture and Fisheries in the course of a reply on March 16, in the House of Commons, animal feedingstuffs coupon issues will be increased from May 1 primarily to assist pig production. During this winter a proportion of the coupons issued has not been used, and these increased rates are announced in order that the existing supply of feedingstuffs can be fully used. Regular monthly rations for pigs will be increased substantially, together with smaller increases in the bonus rates (for pigmeat and eggs), farrowing sow allowances, and in rations for dairy cows (monthly rations in August and September and a new allowance for September calvers).

Other scales will remain the same as last summer. Details are given below :

PIGS AND POULTRY. For each month May to August, *basic rations* for pigs will be 1 cwt. per pig for 33⅓ per cent of the 1939-40 registered number (compared with the existing percentage of 22½ per cent) subject to the usual acreage deduction. For poultry they will be at the usual summer scale, 1½ cwt. per 20 poultry for 1/5th of the number registered in 1939-40. Allowances for sound poultry breeding stock based on the autumn 1948 or the autumn 1949 count (whichever is the smaller) and for pedigree pigs additional to basic rations will remain unchanged.

The "Extended" Scheme of rations for pigs and poultry will continue, and monthly rations for *pigs only* will be increased by 50 per cent in the acreage groups up to 150 acres and by 33⅓ per cent in the groups above that acreage. Although the specified maximum numbers of pigs to qualify for full scale rations are unchanged, the Minister hopes that with the additional rations producers will increase their herds by at least the same proportion as the increase in rations.

FARROWING SOW ALLOWANCE. Raised from 9 to 10 cwt. and can be given at applicant's choice in either 3 cwt. Pig Starter Food and 7 cwt. protein and cereal *or* 10 cwt. protein and cereal (in ratio 1 : 9) coupons.

BONUS RATIONS (available in May on application to County Agricultural Executive Committees or in Scotland to the Department of Agriculture for Scotland). These will be increased for all pigmeat or eggs sold through approved channels to the Ministry of Food. The new rates will be 4 cwt. per 8 score (160 lb.) of pigmeat delivered during the four months January to April and 1 cwt. per 80 dozen gradeable eggs delivered to a Packing Station during the seventeen weeks ended April 26, 1950. These bonus rations will be issued to the *nearest quarter* of a hundredweight. For instance, 49 dozen eggs will earn ¼ cwt., 51 dozen ¾ cwt., but if exactly midway at 50 dozen the bonus will be ¾ cwt. No balances will be carried forward to the next period except for egg producers who deliver less than 10 dozen eggs in the period ended April 26, 1950.

WHEY-FED PIGS. Cereal allowances will be available, in lieu of ordinary rations, *during the whole twelve months commencing March*, at the following rates :

March to June inclusive	1 lb. for every 2 gallons of whey fed to pigs
July to October inclusive	1 lb. " " 1½ " " " " " "
November to February inclusive	1 lb. " " 1 gallon " " " " "

COWS AND CALVES. Rations for May, June and July will be on the same scale as in the corresponding months of 1949, whilst in August and Sep-

tember there will be an increase of 14 lb. per cow on existing rates. These rations will be available, on application to County Agricultural Executive Committees or in Scotland to the local office of the Department of Agriculture for Scotland, for dairy herds with average yields over 1¼ gallons per day. In August an average yield of 1¼—2 gallons, which has not hitherto carried any allowance, will now earn 28 lb. per cow. The ration rate for calves under 6 months old is the same as for last summer.

AUTUMN CALVERS. A special issue of ¼ cwt. protein and 1½ cwt. cereal will be available for cows and heifers *due to calve in September* as well as in October and November. The allowance will be in July and/or August coupons (the latter valid also for September) at applicant's choice. Application should be made to the appropriate County Agricultural Executive Committee or in Scotland to the local office of the Department of Agriculture for Scotland not later than July 15 (for September calvers), and not later than August 15 (for October and November calvers). No special application form is necessary for those farmers who normally claim rations for dairy cows against milk sales since the relative form (S.F.S. 459) for July and August makes provision for applying for the autumn calving allowance.

OTHER ANIMALS. Allowances for horses, goats and other animals will be obtainable under conditions similar to those in operation last summer.

SALES OF PEDIGREE SEED OATS AND OF SEED BEANS AND SEED PEAS OF FEEDING VARIETIES. Arrangements will be made as last year for feedingstuffs coupons (protein) to be supplied on application to County Agricultural Executive Committees or in Scotland to the local office of the Department of Agriculture for Scotland, to growers of beans and peas of feeding varieties from the 1950 harvest who, by selling these crops for seed, have left themselves short of feedingstuffs for the livestocks on their holding. Similarly, coupons (unendorsed cereal) will be issued for *pedigree* seed oats certified under the approved field inspection scheme or under any other such scheme approved by the Seed Production Committee.

The Colorado Beetle The Second Annual Progress Report (for 1949) of the International (European) Colorado Beetle Committee draws attention to the growing interest being shown in the work of the Committee in the countries of Europe. Not only has there been an increase in the exchange of views, correspondence and visits between countries, enabling a greater synchronization of control methods and use of insecticides, but there has also been more interest shown by individual growers.

During the period under review the extensive propaganda campaign carried out in Belgium in 1948 was continued and extended at the expense of the Belgian Government. In Northern France also an intensive campaign was put into force under the Committee's auspices; this included the direct spraying of a large acreage of potatoes, much of this acreage being sprayed by helicopters and aeroplanes. The Netherlands Government continued their comprehensive system of control and campaigns were also carried out in Western Germany. A special collaborative campaign was also organized in the Northern part of Schleswig-Holstein designed to protect Denmark against the northward spread of the beetle. Funds for this campaign were shared between the Danish Government, the German Authorities and the Committee.

Nearly 100 copies of the International Colorado Beetle film have been distributed to centres in Europe, including the film library of the Food and Agriculture Organization. Propaganda exhibitions have been organized

at a number of international fairs while posters and leaflets have been distributed in tens of thousands; in France a leaflet has been distributed in all rural districts.

Close liaison has been established between the Committee and the European Committee of Agricultural Zoology (CEZA), resulting in much useful mutual assistance. Throughout the summer of 1949, an information service was maintained, by means of which the circumstances effecting the appearance of the first beetles, the rate of increase and the necessary condition for survival and swarming have been studied in various countries. A comprehensive programme of observation for this year is being prepared.

Generally speaking, infestation was nowhere very serious in 1949, due partly to weather conditions which tended to prevent the normal development of the beetle. In addition, owing to the drought, potatoes were lifted earlier than usual, thus depriving the beetle of its source of nourishment and causing early hibernation. However, a real danger exists of a serious infestation in the spring of 1950, and early preventive measures are therefore called for.

Individual reports from the various countries indicate the action taken in 1949 to deal with actual and possible infestations. Denmark was invaded for the first time, several small colonies being found mainly near the German frontier. Infestation in Western Germany was widespread and there are fears that the position in 1950 may be serious if the weather is favourable to the pest. The Netherlands, Italy, Luxembourg and France all saw some degree of infestation and a special campaign was conducted in Normandy, of which dusting and spraying operations from the air formed a part. The Jersey authorities took energetic preventive measures to prevent invasion and not a single live beetle was found on the crops in 1949.

Copies of the Report can be obtained free on application to the Ministry of Agriculture and Fisheries, 1 St. Andrew's Place, Regent's Park, London, N.W.1.

Standardized Names for Chemical Compounds

During the last twenty-five years great advances have been made in the development of chemicals for pest, disease, weed and rodent control. In the past ten years in particular many new compounds have been marketed on a world-wide scale for use in the medical, veterinary, agricultural and industrial fields. The chemical names of these compounds have in many instances been too complicated for common use, and shortened forms and trade names have been devised. As there may be several of these applied to one chemical compound, confusion has arisen in commercial descriptions of products and in the scientific literature.

The problem was discussed at the Commonwealth Entomological Conference in 1948, and a resolution passed urging the appointment of a committee to agree common names for established compounds. The Executive Council of the Commonwealth Agriculture Bureaux referred the recommendation to the British Standards Institution, as the appropriate body in the United Kingdom to deal with the matter. A Technical Committee for Nomenclature of Pest Control Products has now been appointed by the B.S.I. and includes representatives of Commonwealth countries, Government departments, scientific societies and manufacturers' organizations. The Committee meets under the Chairmanship of Mr. H. J. Jones, A.R.I.C. who is also Chairman of the Pest Control Products Industry Standards Committee of the Institution, with Dr. Catherine Tinker, A.R.I.C., as Secretary.

The Committee's terms of reference are: "To prepare standards for the nomenclature for insecticidal and fungicidal chemicals and other pest control products". It is working in the closest collaboration with the Standards organizations in Commonwealth countries, and with the Inter-Departmental Committee on Pest Control in the United States of America. Standards organizations in other countries have been informed of the formation of the Committee and of its proposed programme, and it is hoped that it may eventually be possible to arrive at international agreement on nomenclature.

Marketing of Home-Grown Tomatoes *Factors Affecting the Marketing of Home-Produced Tomatoes in Great Britain* (Economic Series No. 51) is the title of a new report compiled by the Marketing Division of the Ministry of Agriculture, in collaboration with the Department of Agriculture for Scotland. It examines a wide range of factual material dealing with production, supply, demand, prices and marketing arrangements, and considers and emphasizes certain features of the marketing problems involved.

The report deals primarily with the marketing of raw tomatoes, but because of their effect on total supply, incidental reference is also made to supplies of tomato products. An endeavour has been made to sketch the course of the industry over a long period, since long-term trends are of great importance.

Space has also been devoted to the discussion of some of the broad problems facing the British tomato industry; the role of production; standardization, grading and packing; storage, conditioning and processing; market intelligence, continuity and balancing of supply; and local and national organization. These chapters will be of particular interest to tomato-growers in view of proposals which are now under consideration for the organization of the industry for marketing purposes under the Agricultural Marketing Acts.

The publication is available from H.M. Stationery Office, price 3s., (3s. 4d. by post).

Hay in the Stack Of what use is it to pick up a good quality hay crop if it is allowed to deteriorate in the stack? Mr. J. G. Stewart, making this point in a recent broadcast, pointed to the twin dangers of stacking too soon and making the stacks too large. We are all apt to stack too soon, he said, with the result that the hay heats up and a high proportion of feeding value is lost. "A 12-foot base is wide enough for any stack, but even so, the inside of the stack is usually heated and the only greenness left is a foot or so on the outside. We need to devise more efficient ways of stack ventilation—something in advance of the stack pulled up through the middle. Ten tons is enough for a stack—that is, about 15 tons carted in, and 10 tons out in spring".

Salt sprinkled into the stack at the rate of 40 lb. per ton at the time of making helps to preserve the green colour and check the formation of mould if the crop has to be led at a slightly higher moisture content than normal (say, 30 per cent as opposed to 20). There is also the incidental advantage of salted hay that it eliminates the need for rock salt in winter feeding.

Good hay is a balanced food, and 7 lb. of it is sufficient for the production of one gallon of milk. We can't afford to waste it.

OFFICIALLY APPROVED INSECTICIDES AND FUNGICIDES

Since the date of the list published in the December, 1949, issue of *Agriculture* (p. 443), the following names of proprietary products have been added to the approved list under the Ministry's Crop Protection Products Approval Scheme.

Lime Sulphur Washes :		
Swift and Sure Lime Sulphur Wash	Mark Smith Ltd.	**C 347**
Stock Emulsion Tar Oil Winter Washes :		
Cremul 73	The Murphy Chemical Co. Ltd.	**E 239**
Benzene Hexachloride Dusts :		
Boots Flea Beetle Dust	Boots Pure Drug Co. Ltd.	**AK 321**
Benzene Hexachloride Sprays		
Agrocide Wettable Powder	Plant Protection Ltd.	**AL 344**
DNC—Petroleum Oil Winter Washes :		
Swift and Sure Standard DNC Petroleum Winter Wash	Mark Smith Ltd.	**AZ 343**
Metaldehyde Slug Baits :		
Boots Slug Destroyer	Boots Pure Drug Co. Ltd.	**BC 323**

A booklet giving the list of proprietary insecticides and fungicides approved up to January, 1950, may be obtained free on application to the Ministry at 1 St. Andrew's Place, Regent's Park, London, N.W.1.

Ministry of Agriculture and Fisheries, Plant Pathology Laboratory, Harpenden, Herts. April, 1950.

BOOK REVIEWS

The Fox. LIONEL EDWARDS. Collins. 21s.

Renowned in fact and fable, no less than by the many inns whose name it adorns, the fox was a contemporary of pre-historic man. Throughout the centuries this Ishmael of the mammal world has been hunted, shot, snared and trapped ; yet he survives. His reputation is almost wholly bad, but not, it seems, altogether deservedly so ; for much is laid at his door (or rather earth) of which he may be innocent. Evidence is often largely circumstantial. As John Gay's dying fox remarked :

Though we, like harmless sheep, should feed,
Honest in thought, in word, and deed,
Whatever hen-roost is decreased,
We shall be thought to share the feast.

But if Mr. Edward's view is mainly from the saddle, it is clear nevertheless that he has sympathy and understanding with the quarry. In this collection of notes the author draws on his thirty years' experience with foxes, both wild and tame. He has much of interest to say about their food, habits and behaviour. The English scene is well described, and chapters are included on the fox and fox-hunting in Scotland, Wales and Ireland. Not least of this book's appeal are the author's eight full colour and twenty-four black and white illustrations—all superbly done.

S.R.O'H.

Animal Breeding (Fourth Edition). L. M. Winters. Chapman and Hall. 27s.

The fourth edition of this well-known textbook has been considerably changed and expanded. The sciences of animal reproduction and animal genetics have made rapid advance in recent years and in this book the practical applications of these to farm animals have been dealt with. The author has himself produced two new breeds of pigs—the Minnesota No. 1 and No. 2—which are now being widely used in the U.S.A., and so his opinions on breeding should command considerable respect. Not only are scientific principles discussed throughout but the ways in which these can be used in application to the larger and slower breeding farm animals are detailed.

The book begins with a short account of the history of domestic animals. The processes of reproduction are described and there are chapters on fertility and artificial insemination. There are interesting illustrations of the way in which the lamb at birth develops from the egg, while the growth of meat animals and the dependence of this on nutrition with relation to heredity is discussed.

Most of the book is devoted to the practical application of genetics to animal breeding. A good account is given of inbreeding and outcrossing with the utilization of hybrid vigour, as has been so successfully used with maize in plant breeding. He concludes that if hybrid vigour is to be made full use of in livestock production, crossbred females need to be utilized as breeders. This is especially so in pigs due to the fact that for half the bacon pig's normal life it is dependent upon its mother for nourishment. He finds for example that the Three-Breed pig has an advantage of 20 per cent in the number of pigs weaned per litter, 60 per cent on the litter weight at weaning, and 3.8 per cent in saving of feed over the corresponding pure breeds. He shows too how these same principles of inbreeding and crossbreeding inbred lines can also be applied to the improvement of pure breeds. Good descriptions are given of the improvements which can be made by "grading up," and of the methods which are used in Progeny Testing: these should prove most useful to those who are engaged in the practice of livestock improvement. Lists are also given of the inherited lethal characters which have been described in farm animals; these are often the cause of much loss in animal breeding. The bad results which frequently accompany inbreeding are in part due to the uncovering of these lethals and sub-lethals.

J.H.

British Tractors and Power Cultivators. J. B. Ashby. Pentagon Publications. 12s. 6d.

Most writers of books on agricultural machinery are careful never to mention the name of an individual manufacturer and they take pains also never to refer to the price of any implement or machine. This reticence is right and proper when the subjects under discussion are techniques and principles, but it is rather refreshing to see a book in which there has been no need for avoidance of commercial detail. In *British Tractors and Power Cultivators*, J. B. Ashby has been able to write with no restrictions of that sort. He gives the detailed specifications of the several models of tractors and motorized implements made by each manufacturer, and the names and addresses of the makers are clearly set down; and he gives the retail prices of the machines and of their separate accessories.

The result is an extremely useful book. Its compilation must have demanded much detailed communication with manufacturers, and much hard work in checking and rechecking the specifications and prices. Anyone who has tried to make for himself a reference file of catalogues, all bound up together and provided with some index system, knows how much work is involved in its preparation. He will also be able to appreciate how much more convenient it is to have a handy well-bound book with all the details contained between one set of covers, than to have to deal with a bulky unwieldy packet of mixed sizes of leaflets.

Although the book would seem at first to be more useful to the agricultural engineer than to anybody else, it may well be that a farmer who is about to buy a tractor or motor hoe would be spending 12s. 6d. very wisely if he bought this book before he made his decision on which make to buy. He would be able to see the specifications and prices of competitive machines appearing within a few pages of each other, printed in the same type and on the same coloured paper.

Each entry is preceded by a general description of the machine and an account of the work it is intended to perform. These descriptions help to make the book more complete, but their wording does tend to emphasize only the good points of each machine and it is to the specifications themselves that the reader should turn when he actually makes his comparisons of one make with another.

H.J.H.

Spade among the Rushes. MARGARET LEIGH. Phoenix House. 12s. 6d.

Margaret Leigh is one of a band of enthusiastic amateurs who have set a fashion in reclaiming crofts or small farms in uninhabited islands, barren moors and remote Highland glens, working practically single-handed under the most primitive conditions, and with no hope of commensurate financial gain. Why do they do it? Miss Leigh, an Oxford graduate with experience of teaching at Reading University, craved freedom and independence. She would rather "live on potatoes in a one-roomed shack, and be my own mistress than earn a thousand a year and own a master . . . the thought that I must do a certain thing at a certain time in accordance with orders from someone else makes me sick. Yet as my own employer I can work 16 hours a day without a murmur." Moreover she had a gift for writing, and agriculture gave her something well worth writing about. There was this further reason for pioneering in the wilds: "However small and poor the croft, I have at least the satisfaction that no one else wants it . . . I can grow most of my own food, supply my neighbours with winter milk and vegetables, and leave one small corner of the Highlands a little better than I found it."

Modern practitioners will find the delving rather dreary and depressing reading. The real value of the book lies in the author's candid yet not unsympathetic analysis of "The Highland Problem". People's passionate interest in the Highlands she ascribes to the natural beauty—"a melancholy, nostalgic beauty that appeals to us in our disillusion"—the call of romance, the almost unconscious love of little bits of land that makes one idealize in indiscriminating fashion the man with the croft. But "these lovers of the Highlands, even when of Highland birth, rarely live in the land of their love. Gazing from a distance they dream and theorize, or else, dwelling in cities where crowds are forever on the move, they are caught up in a whirl of economic and political planning and run here and there after this remedy and that, attending meetings, writing letters to the papers, reading reports." As for the man on the spot, "he rarely takes any practical steps to get what he wants by his own exertions or to improve what he already has . . . and it seems likely that emigration, whether overseas or to the towns, has drained the Highlands of the best and most enterprising, so that the home population, whether it likes it or no, can only breed from its weaker stock."

What can be done? According to the author, very little from the outside. In this respect she seems somewhat to under-rate the importance of State improvement of roads, transport, housing and amenities, and the development of agriculture, forestry, fishing and industry. The State, she says, cannot induce people to stay if they wish to go, nor make them willing to help themselves. What is wanted is a leader of their own blood and tradition, reared among themselves, but with enough intelligence, drive and vision to make them unite. The author believes the problem to be basically a moral, not an economic, one.

J.G.S.

Life in the Country. GODFREY LOCKER LAMPSON. Frederick Muller. 18s.

This is a vivid, frank, and faithful account of the life of a typical country gentleman and all connected with his demesne at the beginning of the present century, and of the gradual disappearance of the squire from the centre of his little world. His time was divided between sport, the management of his estate, and local public duties—the Bench, the County or Parish Council, the Board of Guardians, the Vestry meetings of the living in his own gift, committees and gatherings of all kinds.

Most people will probably agree that there is a good deal the recording angel might set down to the credit of the old régime, for many a landlord has behaved more like a patriarch than as owner or employer to those about him. The author, however, has no illusions—the day of the squire is over, "and it is too frequently a failing to extol a former age at the expense of the present. Landed property is being more and more distributed among the various classes, the shares of individuals in opportunities for self-advancement are becoming more equal; and there is a nearer approach to a general form of greater domestic comfort. The teaching of the schools has penetrated through all the strata. In short, the result has been to leaven the mass of the population with an infusion of culture, to give them more of the amenities of life, a larger influence upon the course of events, and more leisure."

For the benefit of those not old enough to have seen the squire at work and at play, the author presents a series of telling sketches of country life, with its high days and holidays and even occasional affrays with poachers. Reading about the Sheep Dog Trial, the Point-to-Point, and the St. Leger, I was reminded of a honeymoon couple motoring on the mountain road at the Devil's Elbow, the lady driving. "Keep your eye on the wheel, Molly," said the husband, "I will describe the scenery to you afterwards." If her nervous mate possessed the descriptive powers of this author, Molly will have missed very little. I have read many accounts of sheep dog trials, but never one half so realistic and knowledgeable as this.

The author is also a keen naturalist and although his sole habitation, now, is a country cottage in Sussex, he is still able to enjoy life, in the sense of its fullness ever and anon, like Richard Jefferies, slipping off to " thinking places " in the fields and under the trees. The country gentleman of the semi-feudal kind may soon be a thing of the past, a reminiscence, a tradition, but he will never be a figure forgotten altogether so long as this book, with its modest tribute, remains to be read and enjoyed.

J.G.S.

Soil Fertility and Sewage. J. P. J. Van Vuren. Faber. 18s.

The underlying idea of this book is the potential value of town refuses and urban wastes generally as a contribution to soil fertility and the supply of soil organic matter. It describes in detail the procedure adopted in certain South African municipalities for the ten years during and since the war in composting night soil and town refuse. The author, an agriculturist and advisory officer in the Union Department of Agriculture, was put in charge of a scheme designed to save something from the haphazard and wasteful systems of refuse disposal commonly practised and thus supplement the dwindling supplies of natural manures and chemical fertilizers. Influenced by the writings of the late Sir Albert Howard, whose advice was frequently sought in the course of the work, Mr. van Vuren set about his task with the zeal and energy commonly found among composters, and the most interesting sections of the book deal with the operation of his pilot plant in the small township of Ficksburg in the Orange Free State. Like many inland towns in the Union, Ficksburg has no water borne sewage system, and night soil was buried while domestic refuse was dumped. Mr. van Vuren's problem was to bring the two together to produce a mature, inoffensive compost which could be marketed in a dry condition. By trial and error a plant was developed which did this so successfully that with official encouragement, the process has extended to a number of centres of population throughout South Africa and the author estimates that about 110 municipalities were producing some half a million cubic yards of compost per year valued at a quarter of a million pounds. This in itself is no mean achievement. In the course of his operations Mr. van Vuren made valuable observations on the temperature gradients in compost heaps and the effect of temperature changes on the movements of fly larvae. This last point is important for compost heaps of the type in question were ideal breeding grounds for flies. It was found that as the heap heats up the larvae retreat from the hot central areas and accumulate at the sides and top of the heap. The remedy is therefore to turn the sides into the middle before the mature flies emerge.

It is not to be supposed that the composting procedure was accepted readily on all sides and the author sets out some of the practical considerations that arose in presenting the new process to various municipalities. South Africa has actually certain advantages that are not found in the bigger centres of population in Great Britain and Western Europe in that in the smaller townships the collection and transport of night soil is commonly practised and no new personnel have to be recruited. The full salvage of the nutrients contained in sewage from communities already provided with a water borne system is a problem for which a solution is not yet in sight.

Other parts of the book deal with the principles of composting, with lengthy quotations from various papers and articles. There is an interesting section on the general position of organic manures in the Union. Unfortunately, no analyses of the South African composts is given, and there is only very slight numerical evidence as to its effects on crops. The illustrations of various composting arrangements are good.

H.V.G.

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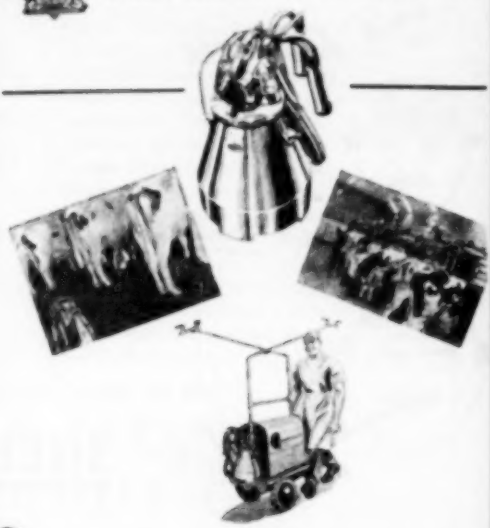

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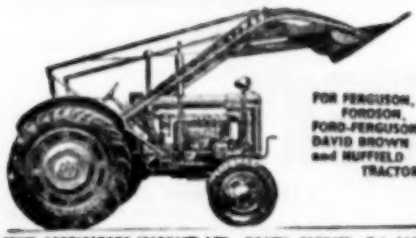

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